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Forest Service

**Forest Pest
Management**

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Forest Insect and Disease Conditions in the United States 1994

1994

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PREFACE

This is the 44th annual report prepared by the U.S. Department of Agriculture, Forest Service, of the insect and disease conditions on the Nation's forests. This report responds to direction in the Cooperative Forestry Assistance Act of 1978, as amended, to conduct surveys and report annually on insect and disease conditions on all forests of the United States. Included in the report are the insect and disease conditions of major national significance in 1994. Insect and disease conditions of local importance are reported in regional and state reports.

As in the past, selected insect and disease conditions are highlighted in the front section of the report. Some of these, for example gypsy moth, have been of concern for a long time. Others, such as the common European pine shoot beetle, are recent introductions.

The second section of the report brings together insect, disease, and abiotic agent damage from each affected region under the organism's or agent's name. The organisms and agents are arranged alphabetically in the appropriate section: insects—native; insects—nonnative; diseases—native; diseases—nonnative; diseases—origin unknown; declines and complexes; seed orchard insects and diseases; nursery insects and diseases; and abiotic damage. These categories are listed in the table of contents; there is no index.

The information in this report is provided by the Forest Pest Management Program of the Forest Service. This program serves all federal lands, including the national forest system and the lands administered by the Departments of Defense and the Interior. The program also provides assistance to private landowners through the State Foresters. A key part of the program is detecting and reporting insect and disease epidemics, and the effects of wind, air pollution, floods, droughts and other agents. Detection surveys are conducted on a regular basis by Forest Service and state program specialists.

For additional information about conditions, contact the Forest Service regional office listed on the next page (see map for office coverage) or your State Forester.

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Forest Service, USDA
Northern Region (R-1)
P.O. Box 7669
Missoula, MT 59807
(406) 329-3605

Forest Service, USDA
Rocky Mountain Region (R-2)
P.O. Box 25127
Denver, CO 80225
(303) 275-5074

Forest Service, USDA
Southwestern Region (R-3)
517 Gold Avenue, S.W.
Albuquerque, NM 87102
(505) 842-3281

Forest Service, USDA
Intermountain Region (R-4)
324 25th Street
Ogden, UT 84401
(801) 625-5252

Forest Service, USDA
Pacific Southwest Region (R-5)
630 Sansome Street
San Francisco, CA 94111
(415) 705-2660

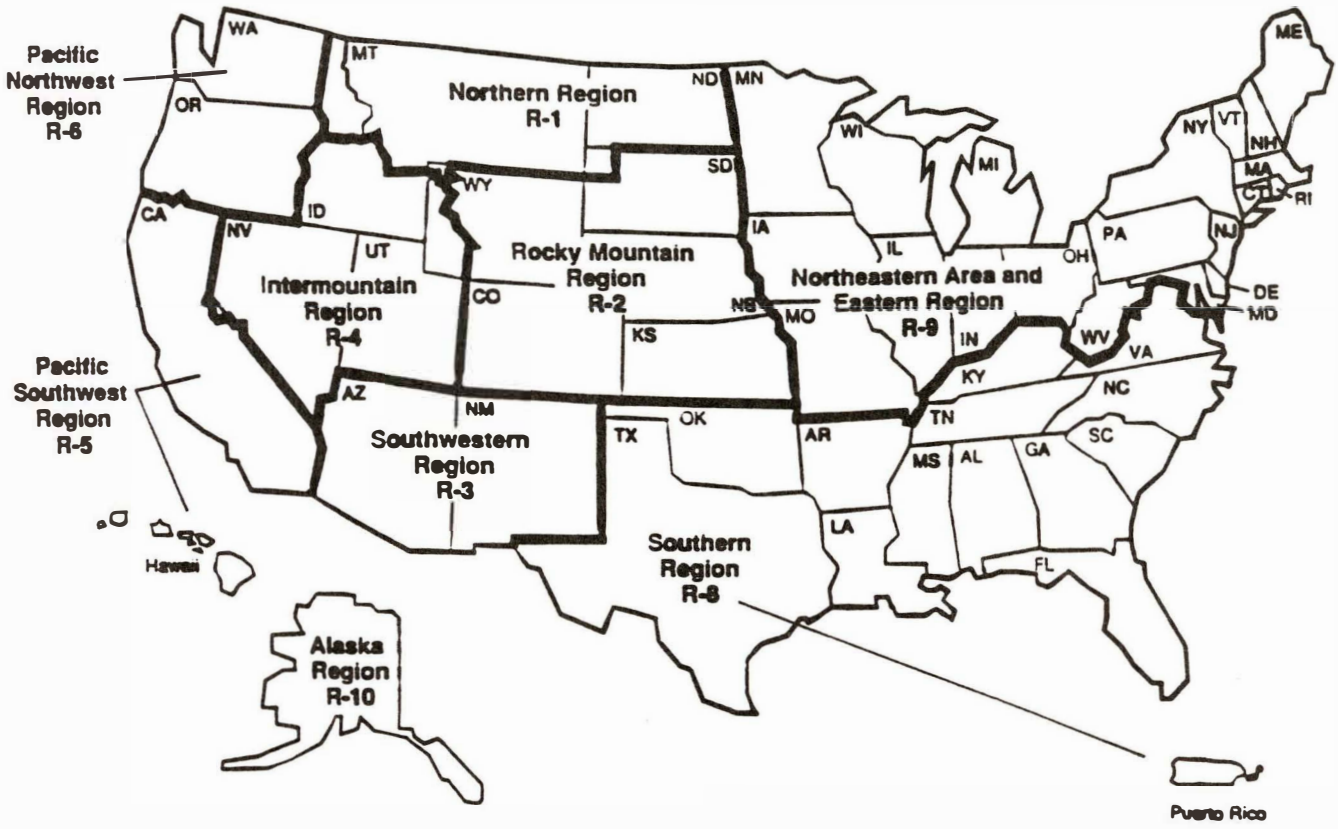
Forest Service, USDA
Pacific Northwest Region (R-6)
P.O. Box 3623
Portland, OR 97208
(503) 326-6666

Forest Service, USDA
Southern Region (R-8)
1720 Peachtree Road, NW, Room 925N
Atlanta, GA 30367
(404) 347-2961

Forest Service, USDA
Northeastern Area
5 Radnor Corporate Center Suite 200
100 Matsonford Road
Radnor, PA 19087
(610) 975-4124

Forest Service, USDA
Alaska Region (R-10)
3301 C Street, Suite 522
Anchorage, AK 99503
(907) 271-2575

USDA Forest Service Regions and Area



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Forest Service, USDA
Forest Pest Management
P.O. Box 96090
Washington, DC 20090-6090

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EXECUTIVE SUMMARY

Introduction

About one-third of the Nation's land area, over 730 million acres, is forested. These forests provide economic, social, and environmental benefits. Native and nonnative, introduced insects and diseases as well as abiotic influences all effect the health and productivity of the forests.

Highlighted below and in Part 1 are some of the major native insects and diseases of concern. Also highlighted are some nonnative insects and diseases that have been introduced into the United States. These pests either are causing serious damage or have the potential to do so.

Insects: native

Southern pine beetle–affected acreage declined by 50 percent to 5 million acres in the Southern Region.

Mountain pine beetle–affected acreage has steadily declined since the early 1980's. Outbreaks exist on about 400,000 acres.

Spruce budworm defoliation increased sevenfold in both Minnesota and Alaska. In the Northeast and the Great Lakes area, populations remain generally low since the large decline in 1986.

Western spruce budworm defoliation is declining westwide, except in New Mexico, where activity increased fourfold.

Spruce beetle continues to affect vast areas in Alaska. Over 600,000 acres were actively infested in 1994.

Insects: nonnative

Gypsy moth (European) defoliated over 880,000 acres of eastern forests in the generally infested area in 1994. Eradication projects were conducted in the South and West to reduce the insect's spread.

Gypsy moth (Asian) feeds on an even greater variety of host species than the European variety and because females can fly, poses a greater risk of spread. An eradication project was conducted in the area around Wilmington, North Carolina, where this insect was introduced in 1993.

Common European pine shoot beetle was discovered in 1992 in Ohio. Beetles have spread into the six states where they are currently found: Illinois, Indiana, Michigan, New York, Ohio, and Pennsylvania. State and Federal quarantines are in force.

Hemlock woolly adelgid was introduced into Virginia in 1950 and has become a serious threat to eastern hemlock. The adelgid was reported on the West Coast in 1920 but is doing little damage there.

Diseases: native

Fusiform rust is the most damaging disease of pines in the South. An estimated 13.7 million acres of pines are affected.

Dwarf mistletoes, native parasites of conifers and a perennial problem in the West, reduced tree growth and killed trees on more than 28.9 million acres in 1994.

Diseases: nonnative

White pine blister rust was introduced about the turn of the century, and now occurs throughout most of the ranges of the five-needled pines, including eastern white pine, western white pine, and sugar pine, causing extensive tree mortality. In 1990, blister rust was found in New Mexico and is threatening the viability of southwestern white pine.

Beech bark disease is the result of an attack by the beech scale followed by invasion of a fungus. The scale was introduced into North America about 1890. The disease is found killing beech trees from Maine to Pennsylvania with outlying spots in West Virginia, North Carolina, and Tennessee.

Diseases: origin unknown

Dogwood anthracnose, first found in 1970's, is now found in 21 eastern states, as well as Washington, Oregon, and Idaho. The disease kills both woodland and ornamental dogwoods.

Butternut canker, found throughout most of the range of butternut, is a threat to the survival of the tree species.

Conditions by Agent

Part 2 of the report provides more detailed information about the above insects and diseases as well as others. The report also describes abiotic factors, such as wind and drought, that damage forests. Often abiotic factors predispose the trees to insect and disease buildups.

Part 1 National Highlights

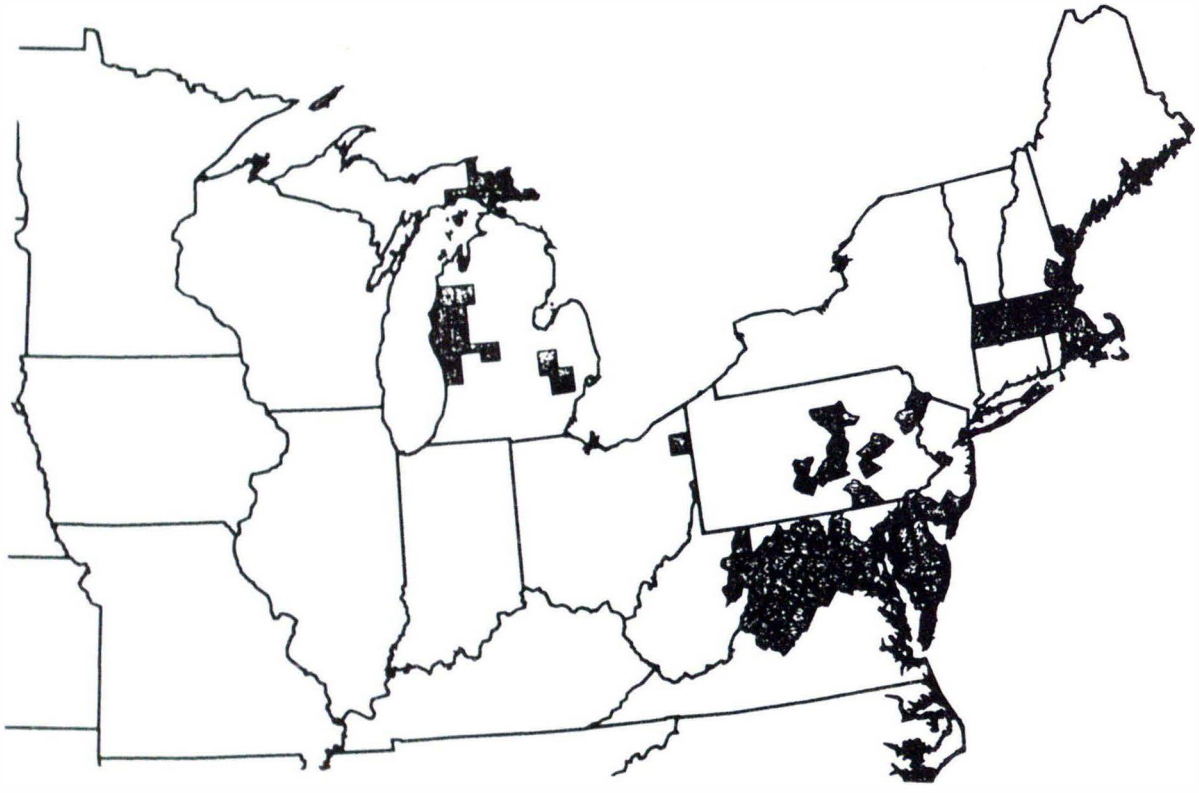
Insect Conditions Highlights

Gypsy moth (European form) (*Lymantria dispar*) was introduced into Massachusetts in 1869, and continues to spread to the south and west. Over 800 thousand acres of hardwood forests were defoliated in 1994. This figure would be higher except for the suppression projects conducted on the highest-valued lands. Aggressive suppression projects in Michigan and Pennsylvania greatly reduced defoliation.

Eradication projects were conducted on outlying infestations of European gypsy moths in Arkansas, North Carolina, Tennessee, Washington, Oregon, and Utah. These projects were conducted by cooperating state and local agencies and the Forest Service.

The Asian form of the gypsy moth was found in Oregon and Washington in 1991 and eradicated in 1992. These moths came from grain ships arriving from Siberian ports. Western states report that several hundred moths (both European and Asian forms) were trapped in 1994. Some were traced to movement of nursery stock and tourist vehicles. Several eradication projects are planned for 1995. In 1993, an infestation was found in the vicinity of Wilmington, North Carolina, with the moths having arrived on ships returning U.S. military equipment from Germany. An eradication project was conducted in 1994, with over 140 thousand acres treated. Follow-up treatments will be necessary in 1995. The Asian form of the gypsy moth is considered more damaging because it feeds on a greater variety of host species and the females can fly. This characteristic greatly enhances the ability of the Asian form to spread. European gypsy moth females do not fly, and spread at the distribution front is limited to 8 to 12 miles per year.

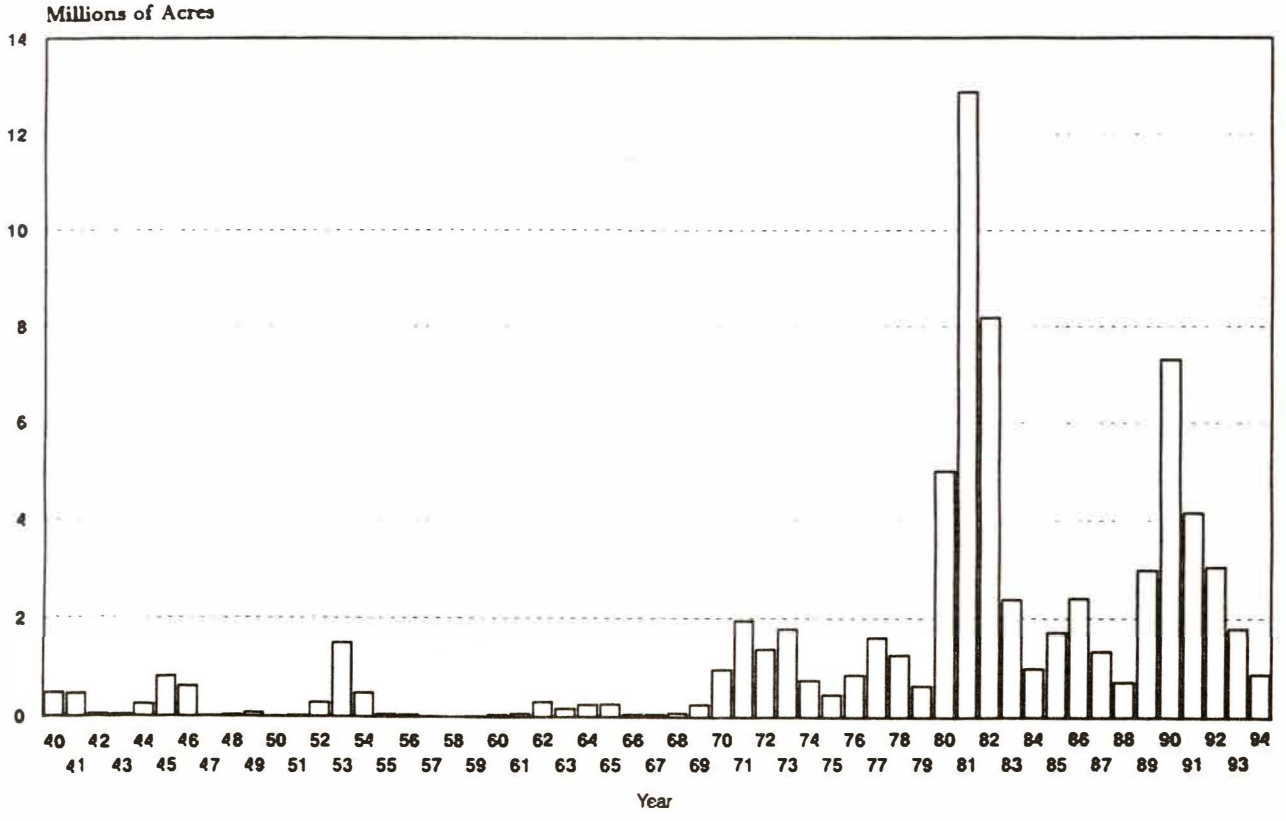
Counties Where Gypsy Moth (European) Defoliation Reported, 1994



Acres of Aerially Detected Gypsy Moth (European) Defoliation, 1990–1994

State	1990	1991	1992	1993	1994
Connecticut	176,576	50,154	31,637	0	0
Delaware	3,790	13,475	4,943	26,700	60,700
Maine	270,433	614,509	278,485	50,700	1,700
Maryland	133,062	75,197	38,704	68,900	93,200
Massachusetts	83,595	282,143	123,794	88,700	76,700
Michigan	358,338	626,689	712,227	399,300	97,300
New Hampshire	133,200	180,870	182,575	10,100	8,100
New Jersey	431,235	169,900	165,960	27,700	17,800
New York	354,162	175,960	60,022	2,000	500
Ohio	115	345	1,130	600	100
Pennsylvania	4,357,700	1,230,066	641,445	318,100	18,000
Rhode Island	0	0	0	0	400
Vermont	63,000	3,596	83	0	0
Virginia	594,000	616,200	748,000	589,100	452,500
Washington, DC	10	125	0	0	0
West Virginia	345,078	112,900	67,508	202,500	53,400
Total	7,304,294	4,152,129	3,056,513	1,784,400	880,400

Gypsy Moth (European) Defoliation, 1940–1994

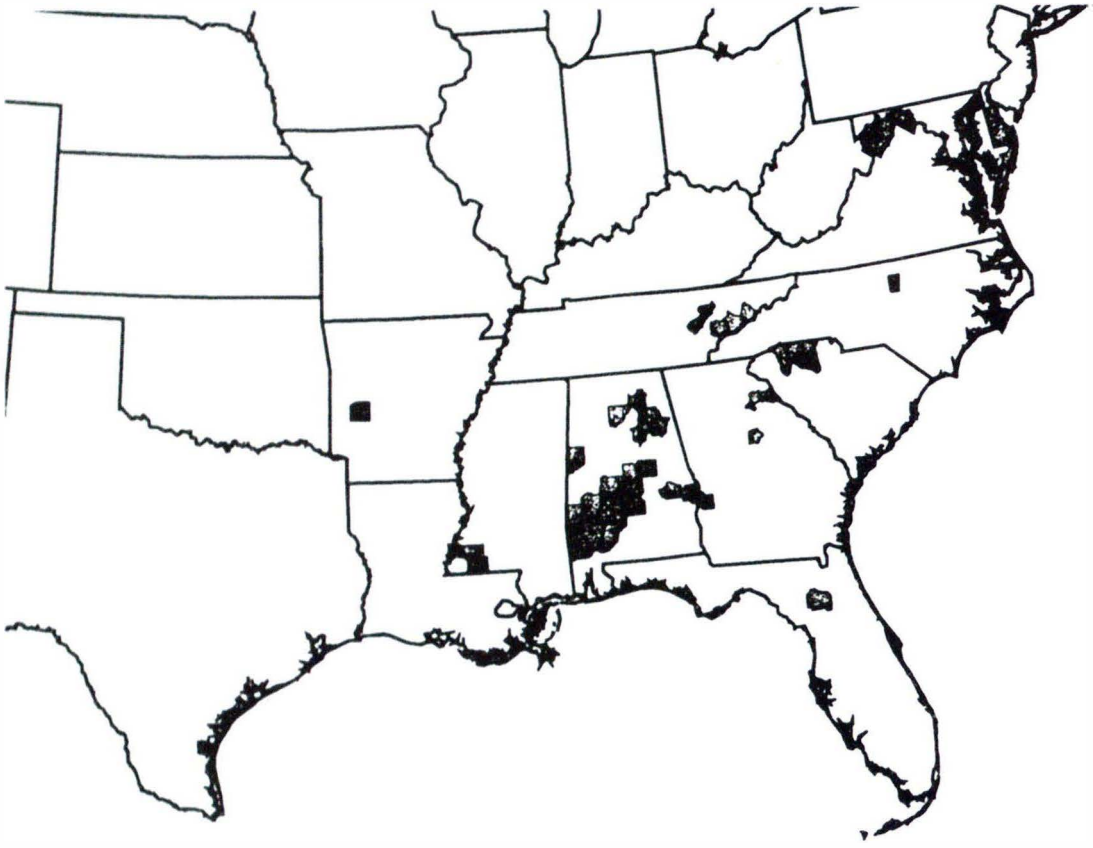


Southern pine beetle (*Dendroctonus frontalis*)

-affected acreage in the South declined 50 percent from 1993 (from 10 to 5 million acres). The number of beetle spots declined in every southern state except South Carolina. Outbreak counties are defined as having one or more multiple-tree infestations per 1,000 acres of host type. In 1993, Virginia recorded the highest number of infestations in the its history (30 outbreak counties). But in 1994, SPB populations plummeted.

Further north, SPB-associated mortality is increasing in West Virginia. But in Maryland, where affected acres had increased substantially in 1993, populations decreased in 1994.

Counties Where Southern Pine Beetle Outbreaks Reported, 1994

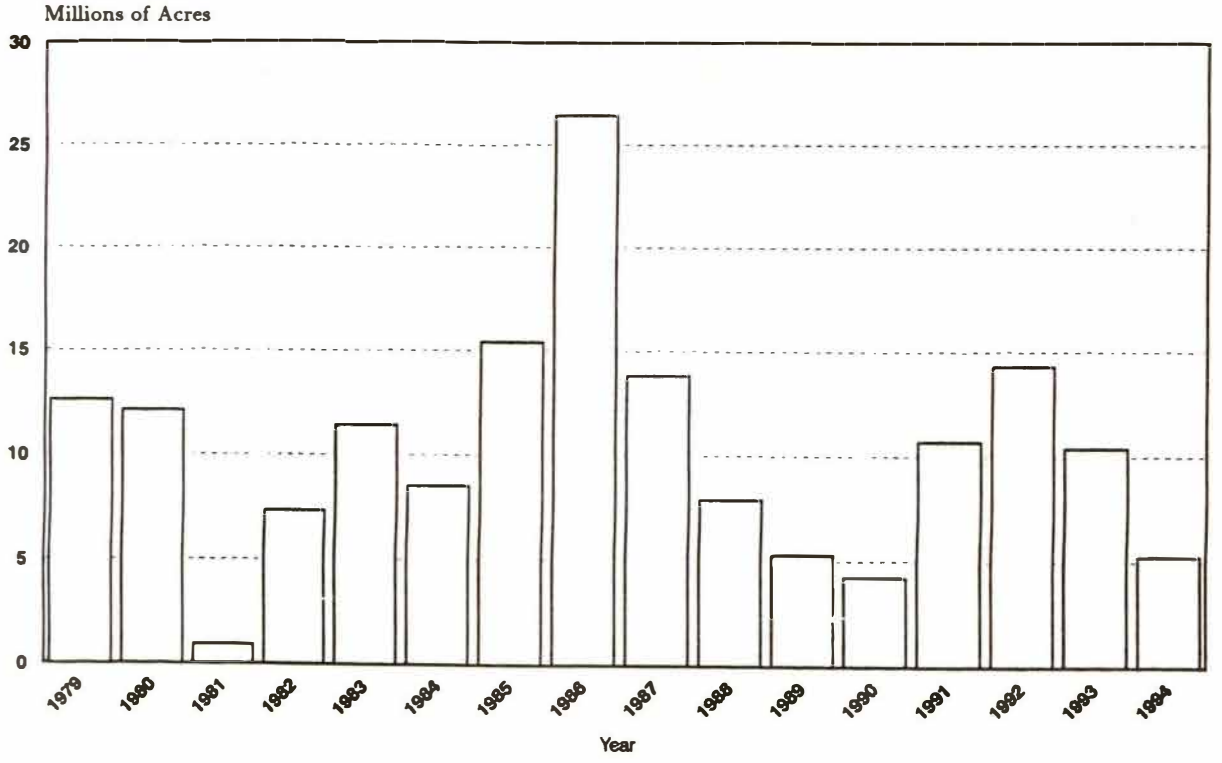


Acres of Southern Pine Beetle Outbreaks in Southern Region (R-8), 1990–1994*

State	1990	1991	1992	1993	1994
			Acres in thousands		
Alabama	0.0	3,937.1	5,815.7	2,753.4	2,951.4
Arkansas	0.0	0.0	55.8	649.1	429.6
Georgia	0.0	346.5	871.0	587.3	315.4
Florida	0.0	0.0	0.0	0.0	97.1
Kentucky	0.0	0.0	0.0	0.0	0.0
Louisiana	0.0	1,197.6	3,112.4	2,291.9	0.0
Mississippi	0.0	1,278.4	406.1	331.5	689.6
North Carolina	111.4	40.1	334.3	569.6	47.9
Oklahoma	0.0	0.0	0.0	0.0	0.0
South Carolina	2,320.7	2,413.6	469.2	366.4	332.8
Tennessee	0.0	0.0	45.9	173.0	148.6
Texas	1,800.0	1,495.9	2,663.3	1,106.8	238.3
Virginia	0.0	35.0	533.6	1,584.6	0.0
Total	4,232.1	10,744.2	14,307.3	10,413.6	5,250.7

*Acres of outbreak are acres of host type having one or more multi-tree spots per 1,000 acres.

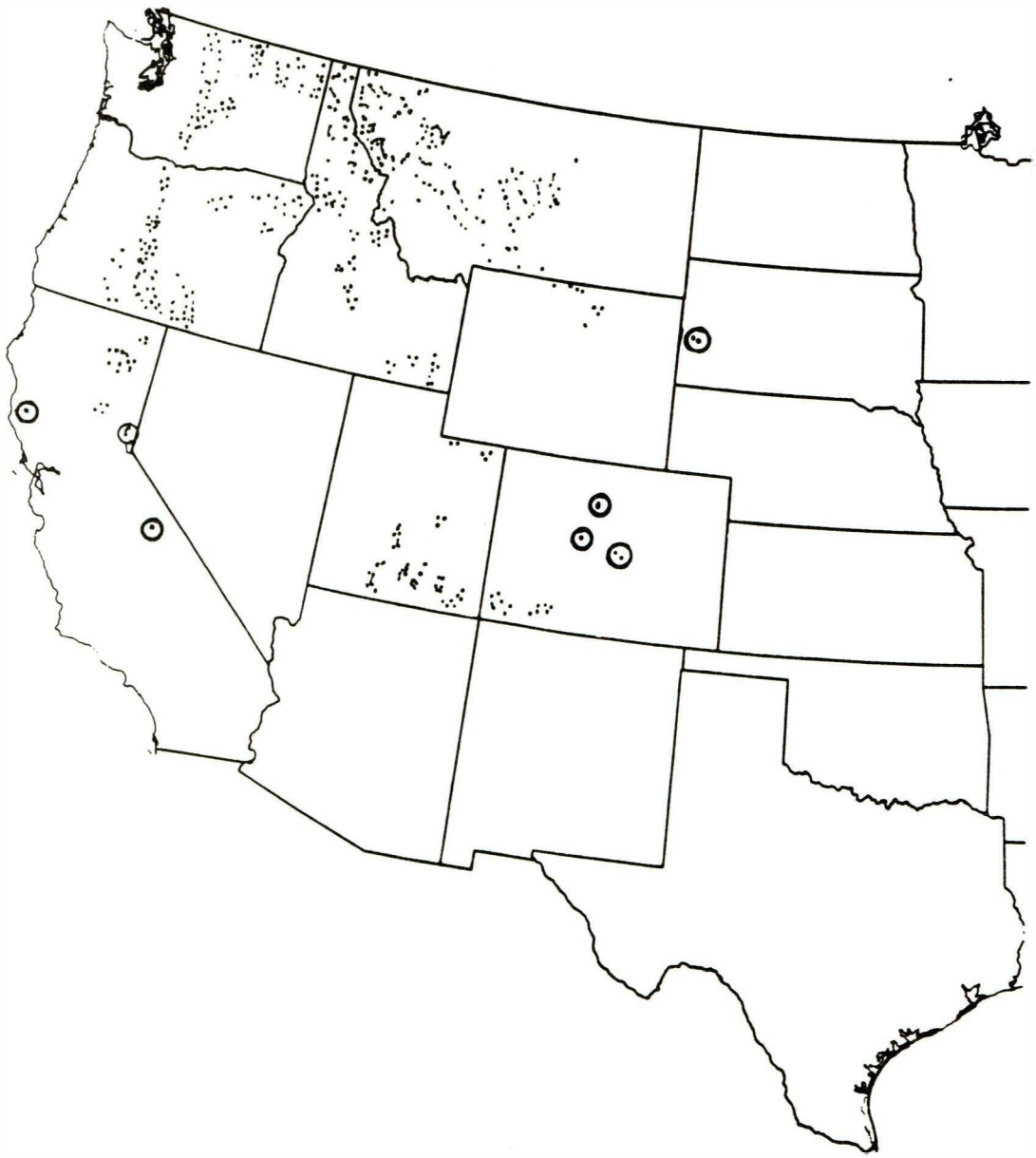
Acres of Southern Pine Beetle Outbreaks in Southern Region (R-8), 1979–1994.



Mountain pine beetle (*Dendroctonus ponderosae*) attacks lodgepole, ponderosa, sugar, and white pines. During epidemics, tree mortality can increase fire hazard, permit intrusion of less desirable timber species, and affect wildlife species composition.

In the last decade, affected acreage has steadily declined. Still, about 600,000 trees were killed on about 400,000 acres in 1994. California, Oregon, and Washington are the states most affected. Very small scattered infestations are neither mapped nor acreages reported.

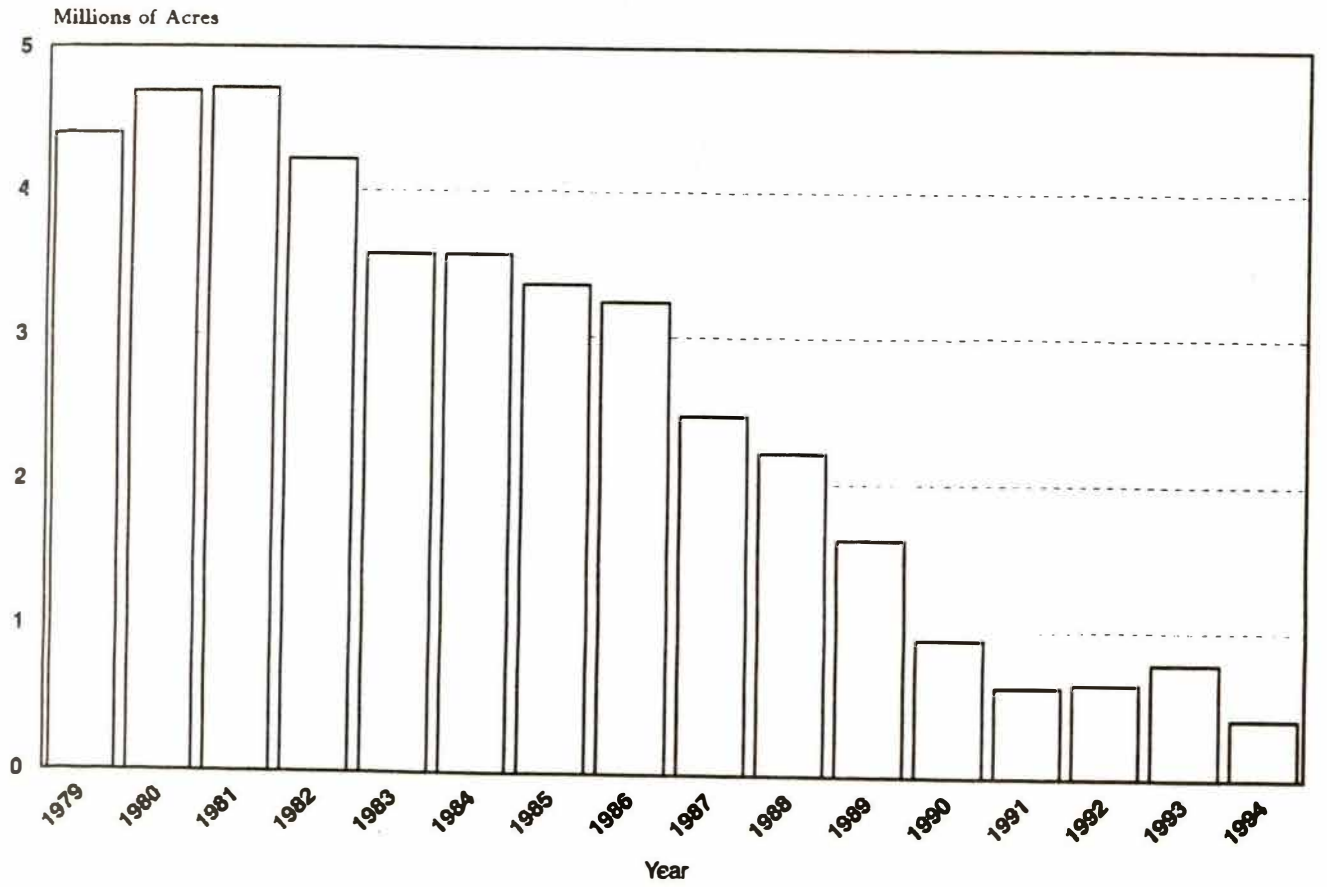
Mountain Pine Beetle Outbreak Areas, 1994



Acres of Mountain Pine Beetle Outbreak, 1990–1994

State	1990	1991	1992	1993	1994
			Thousand acres		
Arizona	0.6	0.0	0.0	0.0	0.2
California	---	---	---	121.0	115.0
Colorado	9.8	1.5	0.0	0.0	1.2
Idaho	15.2	22.5	22.4	43.7	7.8
Montana	195.2	160.0	65.9	43.4	19.2
New Mexico	0.8	1.4	1.2	1.4	2.8
Oregon	245.1	249.6	303.0	345.6	161.1
South Dakota	6.8	10.0	13.6	13.6	1.4
Utah	2.0	1.3	4.1	10.0	18.7
Washington	431.7	155.4	125.2	200.3	76.4
Wyoming	28.3	15.4	106.0	2.8	1.6
Total	935.5	617.1	641.4	781.8	405.4

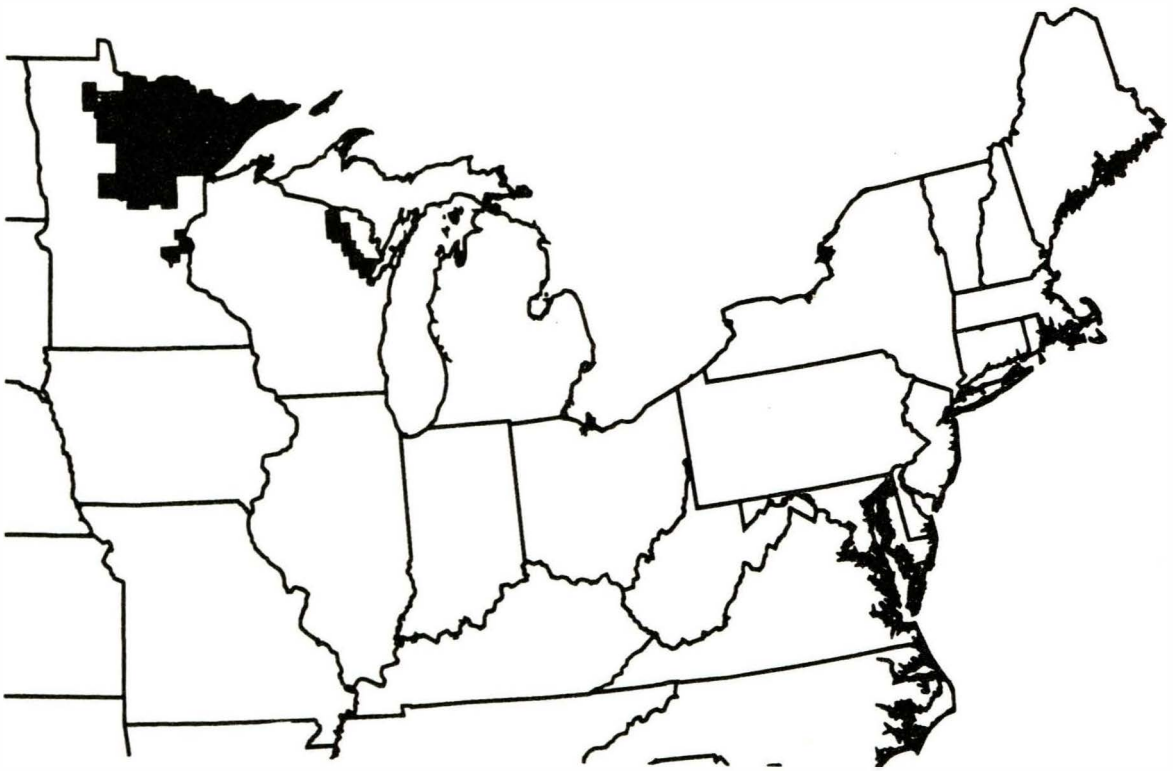
Mountain Pine Beetle Infestations, 1979–1994.



Spruce budworm (*Choristoneura fumiferana*) is a native insect found in northern New England, New York, the Great Lakes area, and Alaska. In the Northeast and the Great Lakes, the acreage defoliated remains low following the outbreaks of the late 1970's and early 1980's.

In Alaska, however, defoliation increased sevenfold in 1994. In Alaska, two other budworm species, *C. orae*, *C. biennis*, contributed to spruce defoliation.

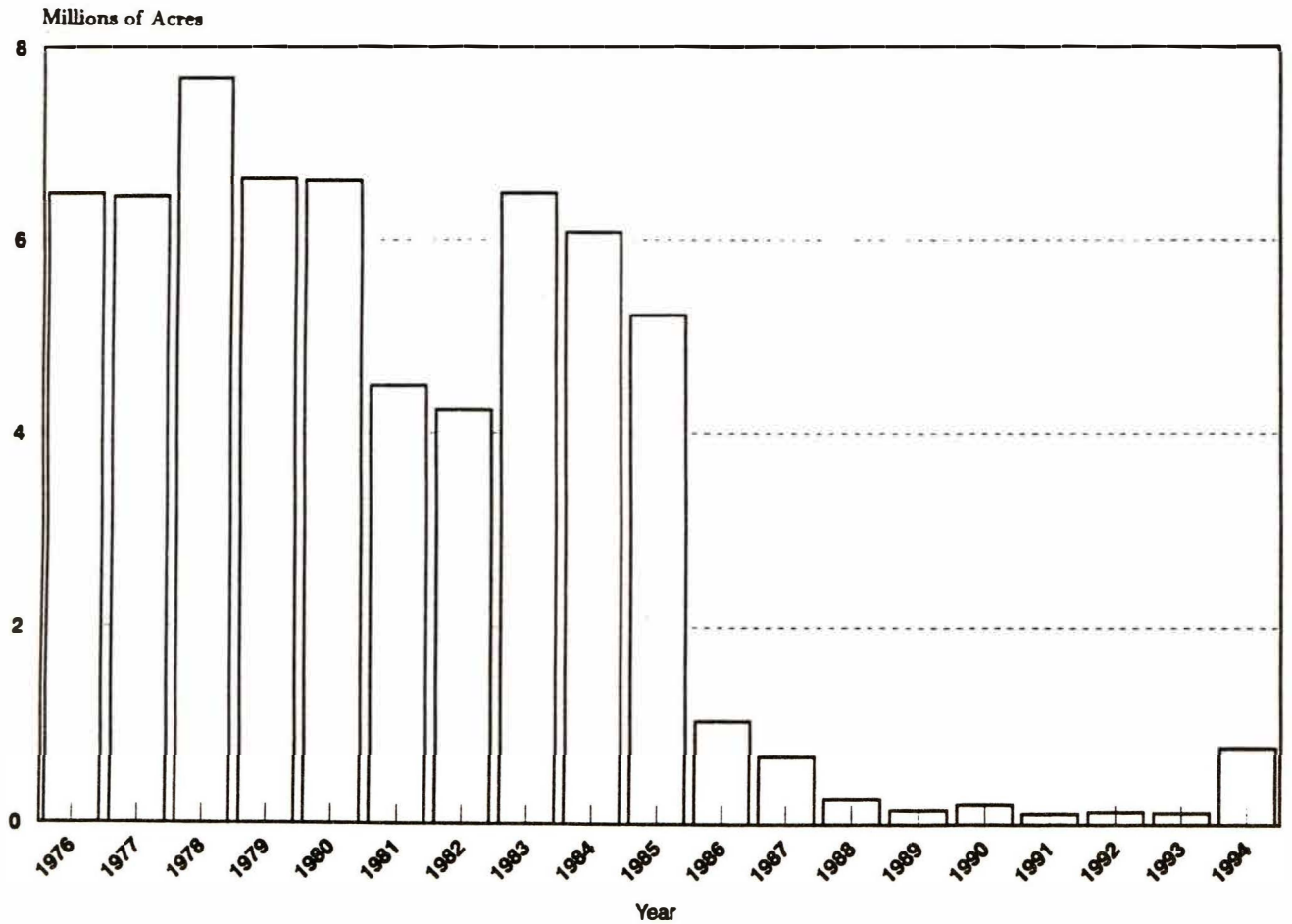
Counties Where Spruce Budworm Defoliation Reported in Eastern United States, 1994



Acres of Aerially Detected Spruce Budworm Defoliation, 1990–1994

State	1990	1991	1992	1993	1994
			Acres in thousands		
Alaska	---	25.0	160.0	33.0	232.5
Maine	0.0	0.0	0.0	0.0	0.0
Michigan	2.5	0.0	0.0	0.0	6.8
Minnesota	198.0	108.0	126.0	116.0	770.5
New Hampshire	0.0	0.0	0.0	0.0	0.0
New York	0.0	0.0	0.0	0.0	0.1
Vermont	0.0	0.0	0.0	0 0	0.0
Wisconsin	0.0	0.0	0.0	0.0	1.0
Total	200.8	133.0	286.0	149.0	1010.9

Spruce Budworm Defoliation in the Eastern United States, 1976–1994.



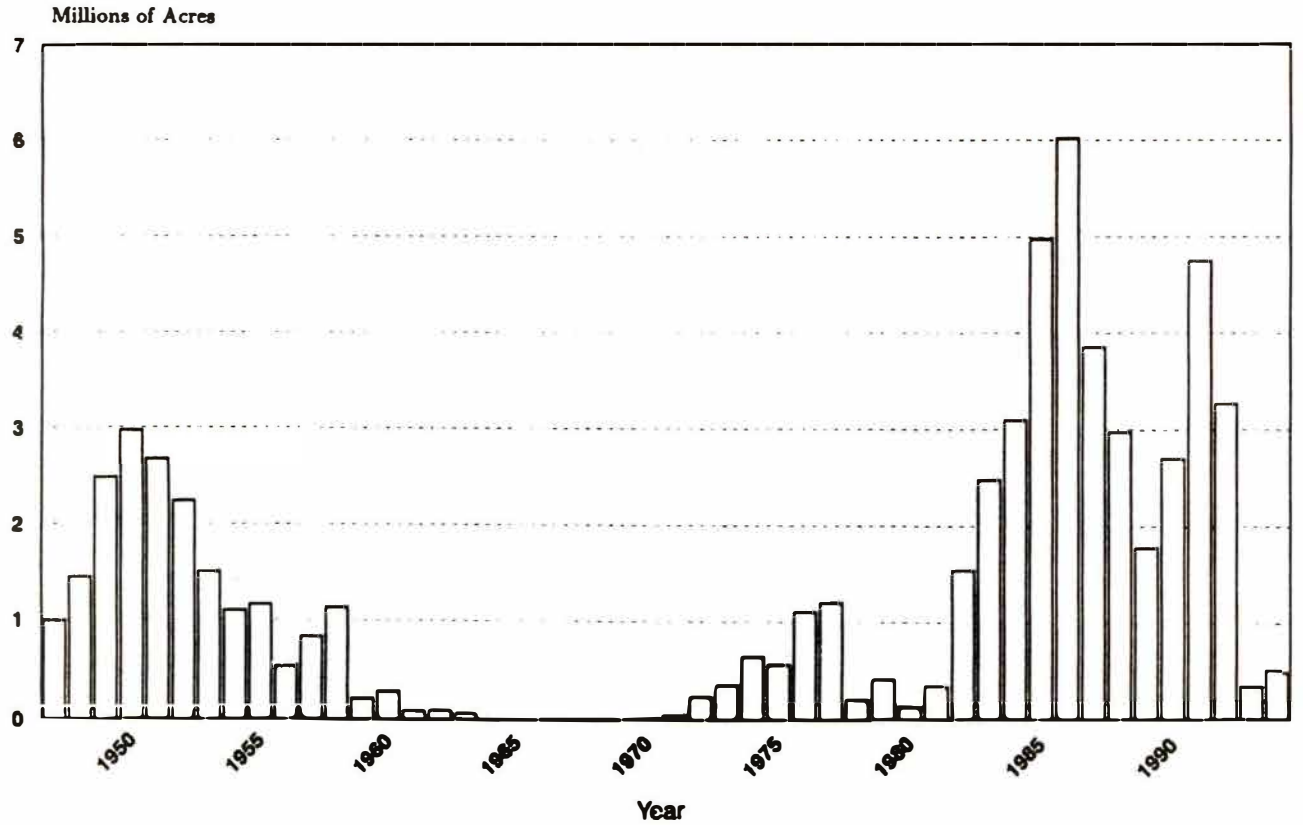
Western spruce budworm (*Choristoneura occidentalis*) defoliation decreased drastically in most of the west. No defoliation was observed in the Intermountain Region for the first time since the early 1960's. However, in New Mexico, defoliation increased almost four and one-half times. Small scattered acreages are not mapped.

Western Spruce Budworm Defoliation Areas, 1994

Acres of Aerially Detected Western Spruce Budworm Defoliation, 1990–1994

State	1990	1991	1992	1993	1994
			Acres in thousands		
Arizona	25.6	0.0	11.5	0.0	0.0
California	0.0	0.0	0.0	0.0	0.0
Colorado	52.1	509.0	272.2	1.2	0.0
Idaho	48.0	61.5	89.8	0.9	0.0
Montana	1,492.4	1,595.7	941.3	44.2	2.4
New Mexico	310.5	218.6	9.4	66.4	369.2
Oregon	2,344.3	3,724.9	1,937.7	87.7	37.4
Utah	0.0	0.0	0.0	0.0	0.0
Washington	351.0	1,027.7	1,329.5	243.8	85.4
Wyoming	8.1	33.5	2.5	2.5	1.1
Total	4,632.0	7,170.9	4,593.9	446.7	495.5

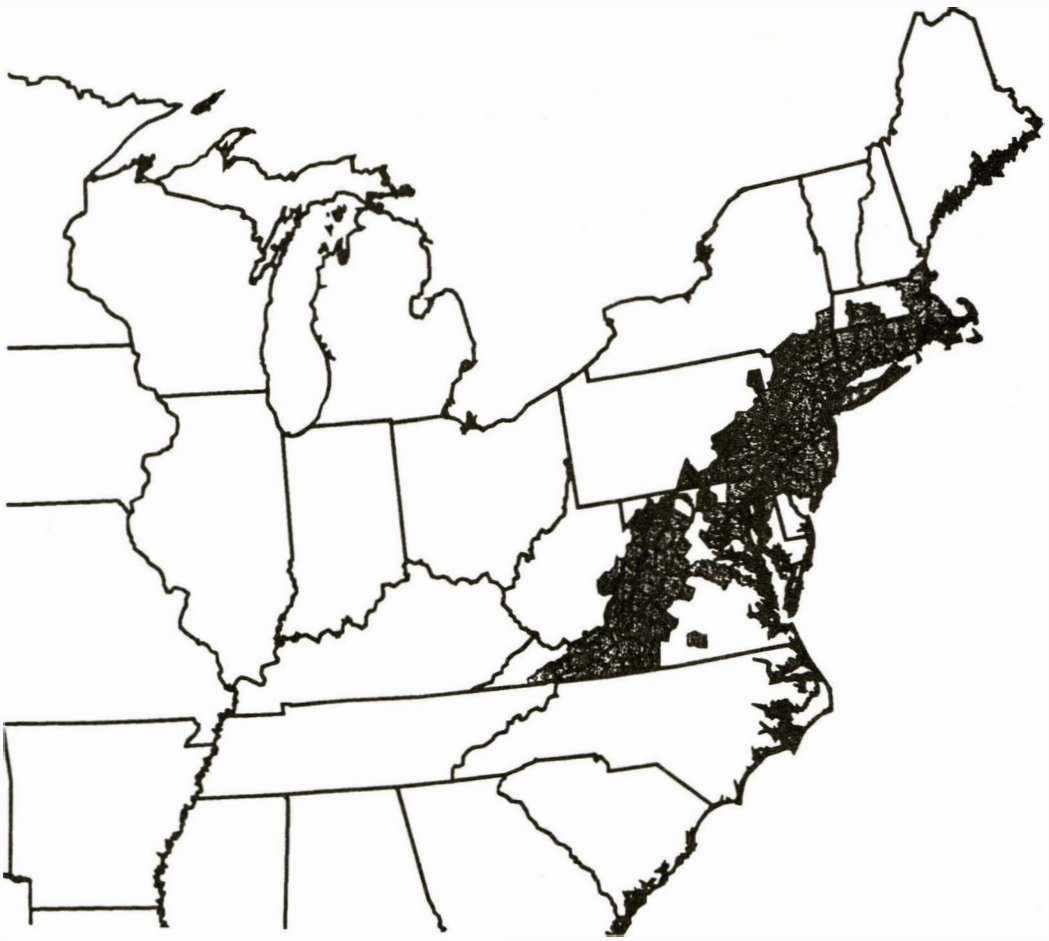
Western Spruce Budworm Defoliation in Pacific Northwest Region (R-6), 1947–1994.



Hemlock woolly adelgid (*Adelges tsugae*) was reported on the West Coast in 1920's, probably imported from Asia. The adelgid does very little damage in western forests, but sometimes kills ornamental trees.

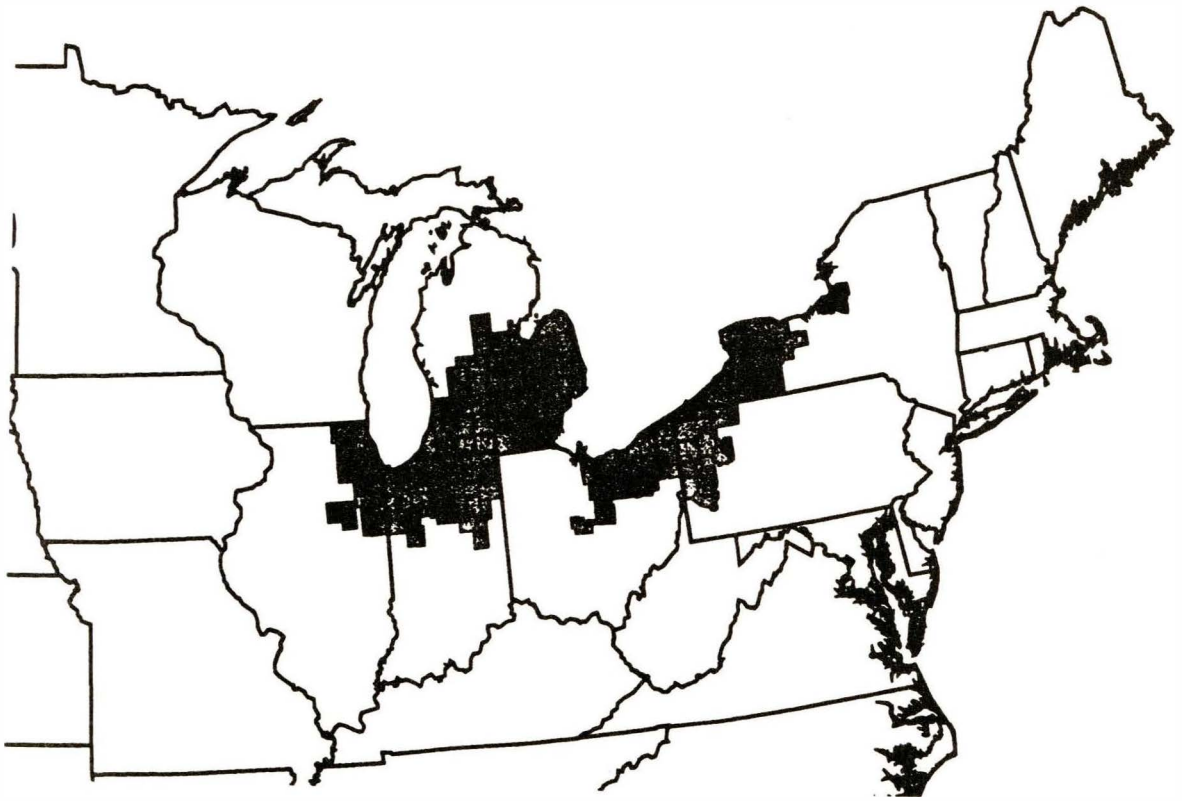
The hemlock woolly adelgid poses a serious threat to the eastern hemlock, however. The adelgid can kill eastern hemlock in 3 to 5 years. In 1950 the insect was introduced into Virginia and has spread north into southern New England. In Virginia, hemlocks are infested, except for those in the southwestern counties, and decline and mortality are extensive. In the Northeast, new infestations were found in Connecticut, Massachusetts, and Rhode Island.

Counties Where Hemlock Woolly Adelgid Reported, 1994



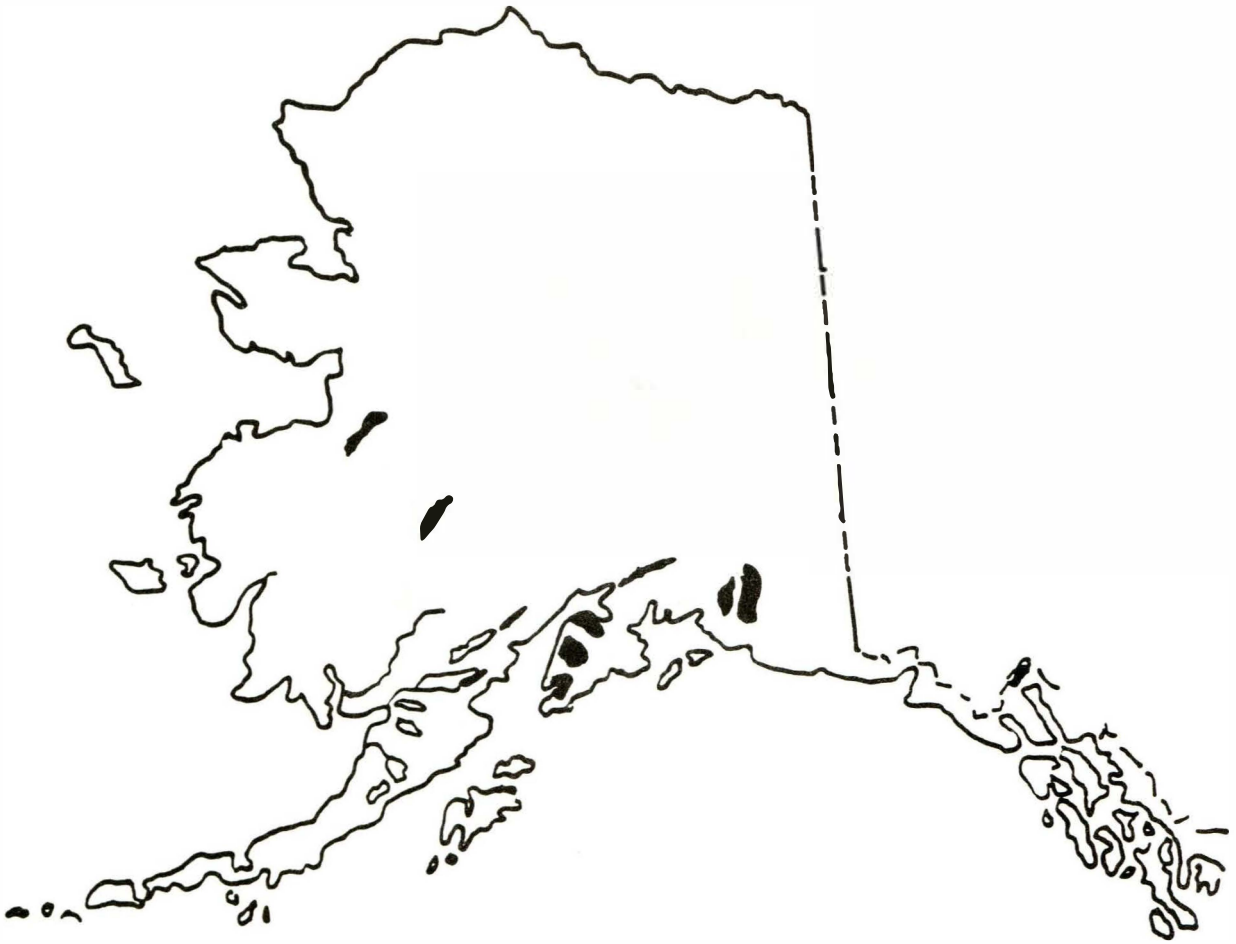
Common European pine shoot beetle (*Tomicus piniperda*) was discovered near Cleveland, Ohio, in 1992. It is now found in six states. The beetle continued to spread within each of these states in 1994. Infested counties have been placed under state and federal quarantine to prevent movement of this beetle to new areas. The beetle prefers Scotch pine but feeds on other pines as well. Thus far, it is a problem mainly for Christmas tree growers.

Counties Where Common European Pine Shoot Beetle Reported, 1994



Spruce beetle (*Dendroctonus rufipennis*) is a native insect that occurs across northern North America and south in the Rocky Mountains to Arizona. Besides loss of merchantable trees, infestations affect habitat quality for wildlife and fish, reduce scenic quality, and increase fire hazard and long-term ecosystem conversion. Although the rate of spread of spruce beetle declined, about 650,000 acres were actively infested in 1994, mostly in Alaska. The outbreak is largely on state and private lands.

Spruce Beetle Areas in Alaska, 1994



Disease Conditions Highlights

Root disease fungi, especially those causing annosus root disease (*Heterobasidion annosum*) and armillaria root disease (*Armillaria* spp.), are among the most serious pests in the West. Mortality is particularly severe in drought-stricken stands where root diseases and bark beetles work together. Damage has increased greatly over the century because of altered forest conditions and structure due to fire control and past management practices.

In the South, annosus root disease is significant in pine plantations, especially those where trees have been thinned. The fungus enters tree stumps and spreads through root grafts to infect living trees. Bark beetle infestations often occur in diseased stands. Root-diseased trees become hazardous in recreation areas and along roadsides.

White pine blister rust is an introduced fungus (*Cronartium ribicola*) that was first found in New York in 1906. The disease has spread throughout the range of eastern white pine. The disease was found for the first time in western North America in 1921 in British Columbia. It has spread throughout much of the West affecting western white pine, sugar pine, and to some extent high-elevation five-needle pines and causing significant tree mortality. In 1990, the disease was found affecting southwestern white pine in New Mexico, where in 1994 about one-half million acres were affected.

Fusiform rust (*Cronartium quercuum* f. sp. *fusiforme*), a native fungus, continues to be the most damaging disease agent of loblolly and slash pines in the South. An estimated 13.7 million acres of pines are affected. Acres are classified as affected if more than 10 percent of the trees have potentially lethal cankers. Georgia is the most seriously affected state, with 4.6 million acres, (49 percent) of host type affected. A revised method used in 1993 for analyzing infection data from previous years' surveys precludes making comparisons to previous conditions reports.

Acres Affected by Fusiform Rust, 1994*

State (survey year)	National Forest System	Other Federal	State and Private	Total
		Acres in thousands		
Alabama (90)	7.1	0.0	1,704.2	1,711.3
Arkansas (88)	0.0	0.0	166.9	166.9
Florida (87)	20.8	9.8	1,135.9	1,166.5
Georgia (89)	38.0	102.8	4,452.9	4,593.7
Louisiana (91)	85.0	18.4	1,554.9	1,658.3
Mississippi (87)	121.2	0.0	1,147.9	1,268.4
North Carolina (90)	4.9	7.8	956.2	968.9
Oklahoma (92)	0.0	0.0	33.9	33.9
South Carolina (86)	63.8	52.3	1,539.4	1,655.5
Texas (92)	21.8	0.0	397.3	419.1
Virginia (92)	0.0	0.0	59.3	59.3
Total	362.6	191.1	13,148.1	13,701.8

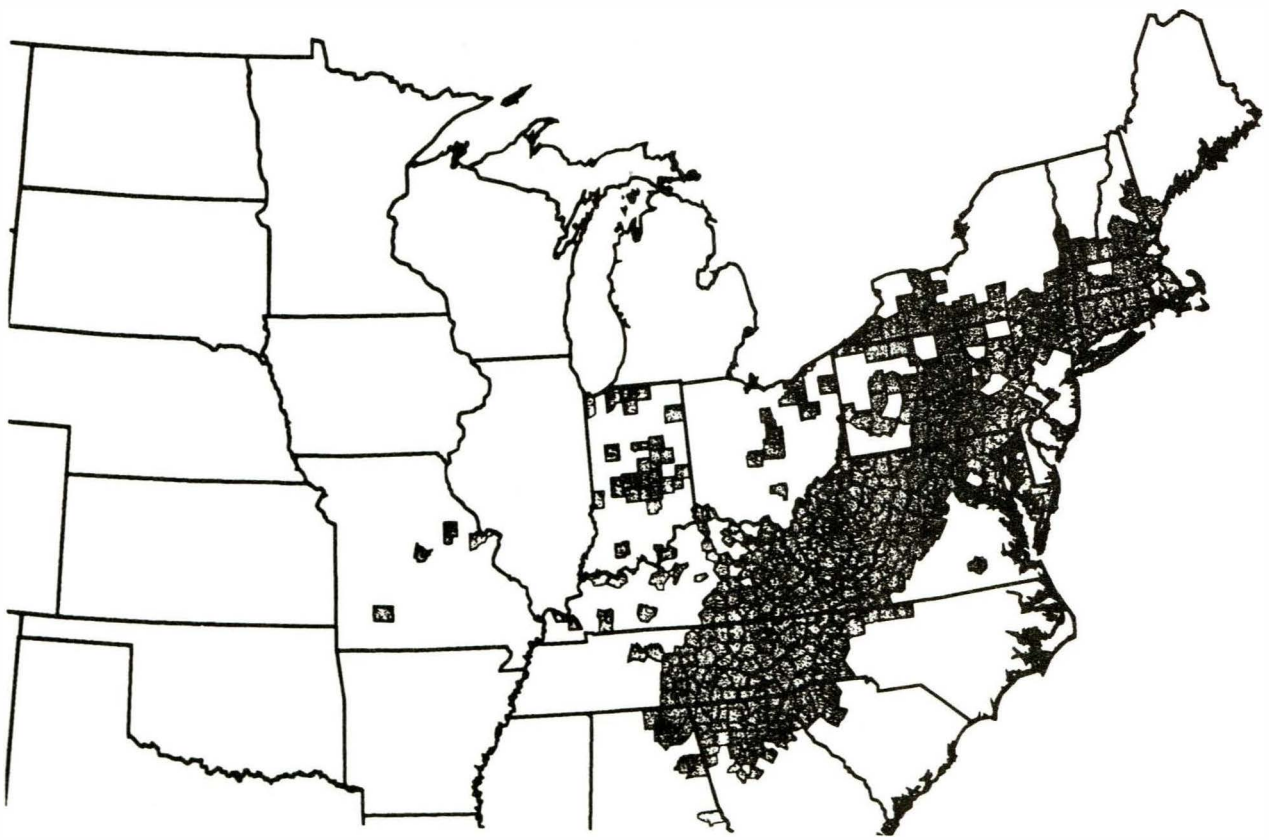
*Acres with greater than 10 percent infection.

Dogwood anthracnose is caused by the fungus (*Discula destructiva*) of unknown origin. The fungus may have been introduced or a previously innocuous fungus may have become a significant pathogen. The disease was first discovered in the Pacific Northwest in 1976. It is now confirmed in Idaho, Oregon, and Washington.

In the East, it was first found in southeastern New York in 1978. By 1987, it was found in 9 eastern states from Massachusetts to Georgia, and by 1994 it was confirmed in 21 states from Maine to Alabama and west as far as Indiana and Missouri. Infected nursery shipments are implicated in this most recent western spread, but in Indiana at least, native stands are now infected. The disease affects both woodland and ornamental dogwoods. Damage is most severe at higher elevations and in cool, moist areas in lower elevations.

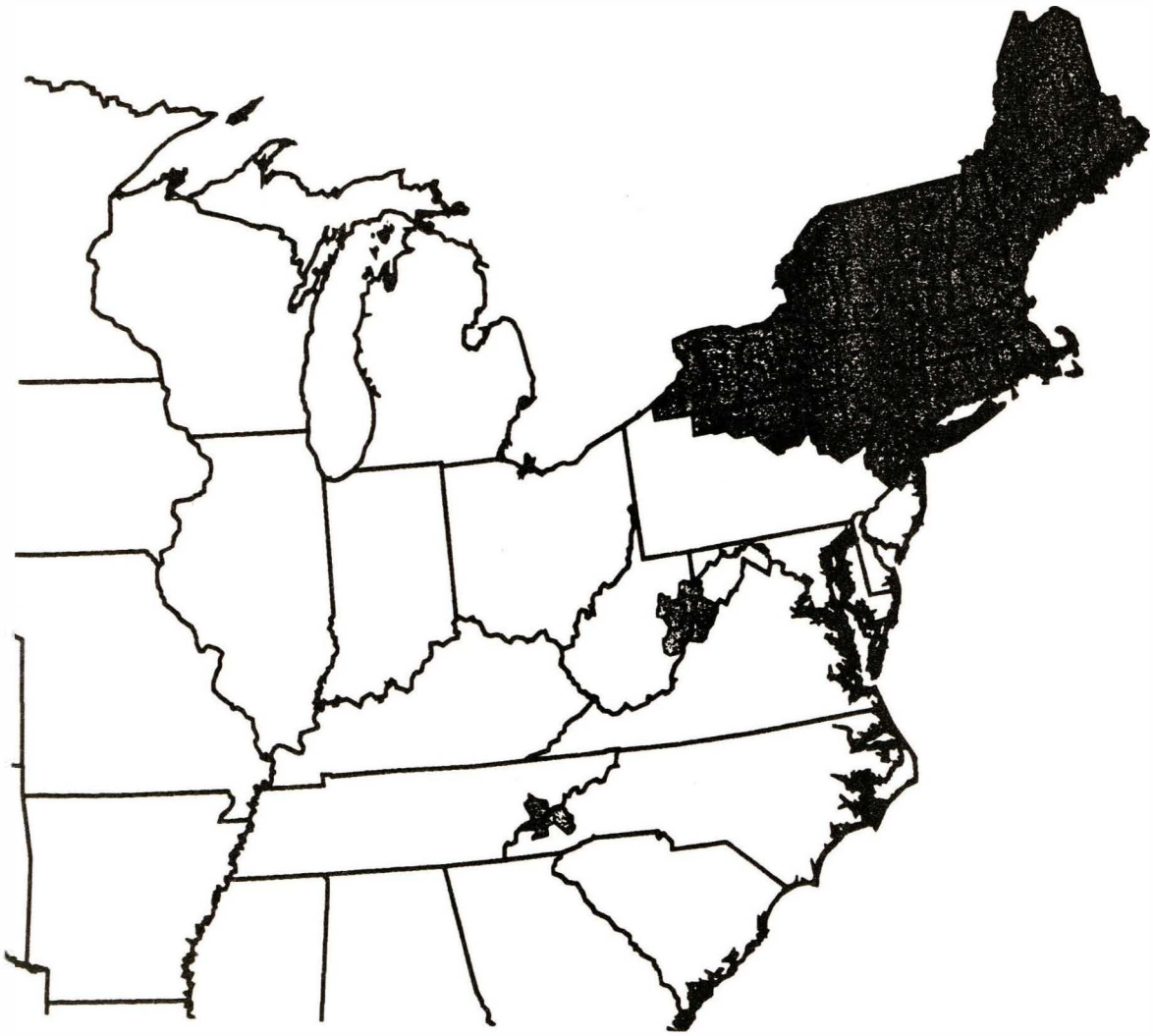
Although the Pacific dogwood is more susceptible than the eastern dogwood, drier summers in the west reduce the number of infection cycles. Thus although significant mortality has occurred in the Pacific Northwest, the problem is not as severe as it is in the East.

Eastern Counties Where Dogwood Anthracnose Reported, 1994



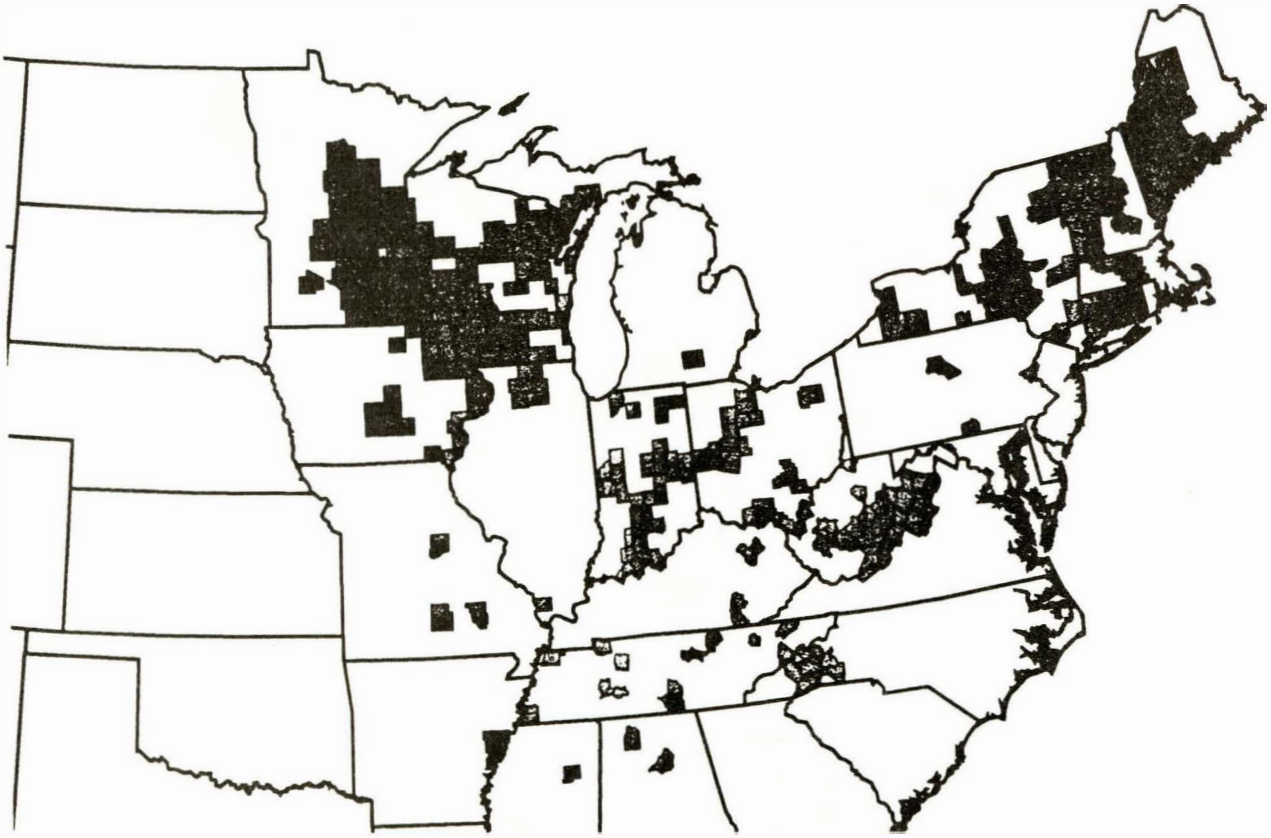
Beech bark disease is the result of an attack by the beech scale *Cryptococcus fagisuga* followed by the invasion of several species of *Nectria* fungi. About 1890, the scale was accidentally introduced into eastern Canada. By 1932, the disease was killing trees in Maine and, by 1981, had spread to West Virginia. In 1994 the disease was found affecting approximately 100 acres on the North Carolina–Tennessee border, about 300 miles southwest of its previously known distribution.

Counties Where Beech Bark Disease Reported, 1994



Butternut canker is caused by the fungus *Sirococcus clavigignenti-juglandacearum*. The origin of the fungus is unknown. Symptoms of the disease have been recognized since the early 1900's, but the causal fungus was not identified until the late 1970's. The disease is found throughout much of the range of butternut and is a serious threat to the survival of the species. In the Southeast, 77 percent of the trees are already dead. The Forest Service and some states have imposed a moratorium on harvesting healthy trees in the hopes of finding resistant stock.

Counties Where Butternut Canker Reported, 1994



Dwarf mistletoes (*Arceuthobium* spp.) are parasitic plants that invade the branches of host trees. This disease is associated with much of the tree mortality in the West. Conifers on more than 27 million acres of western forests are infected. The disease reduces tree growth, kills tops, branches, and entire trees. About 180 million cubic feet of wood are lost annually. Most of the volume loss is caused by 7 of the 16 dwarf mistletoe species: those on Douglas-fir, lodgepole pine, true fir, western hemlock, western larch, and 2 species on ponderosa pine.

Acres in West Affected by Dwarf Mistletoes, 1994

State (survey year)	National Forest System	Other Federal	State And Private	Total
		Acres in thousands		
Alaska *	3,060.0	0.0	340.0	3,400.0
Arizona (85-89)	1,040.0	674.0	25.0	1,739.0
California (80-90)	2,276.0	69.0	1,911.0	4,256.0
Colorado (79,82)	638.0	---	---	638.0
Idaho, North (70-80) **	478.0	10.0	224.0	712.0
Idaho, South (94) **	2,961.6	---	---	2,961.6
Montana (70-80)	1,694.0	123.0	600.0	2,417.0
New Mexico (85-89)	1,140.0	348.0	581.0	2,069.0
Nevada (94)	58.9	---	---	58.9
Oregon (67)	2,703.0	505.0	2,470.0	5,678.0
Utah (94)	432.2	---	---	432.2
Washington (76)	1,137.0	43.0	2,760.0	3,940.0
Wyoming (94)	605.3	---	---	605.3
Total	18,162.0	1,772.0	8,911.0	28,907.0

*Commercial acreage only in Alaska. Data based on years of knowledge of the resource and the disease.
**Idaho North is in Region 1, and Idaho South is in Region 4.

Part 2 Conditions by Damage Agent by Region

Insect Conditions by Region

Insects: Native

Birch skeletonizer, *Bucculatrix canadensisella*

Region 9/Northeastern Area: Maine

Host(s): Gray birch, yellow birch, white birch

Populations of caterpillars and browning could be observed on birch, but numbers and severity seemed to be down. Approximately 1,500,000 acres have been defoliated by this pest in Maine.

Cherry scallop shell moth, *Hydria prunivorata*

Region 9/Northeastern Area: Michigan, New York, Pennsylvania, West Virginia, Wisconsin

Host(s): Black cherry, pin cherry

Caterpillars of the cherry scallop shell moth defoliated cherry trees over 321,818 acres of forests in Michigan, New York, Pennsylvania, Wisconsis, and West Virginia. Pennsylvania alone accounted for almost 290,000 acres.

Douglas-fir beetle, *Dendroctonus pseudotsugae*

Region 1: Idaho, Montana, Wyoming

Host(s): Douglas-fir

Acres infested by the Douglas-fir beetle increased in the Northern Region from 1993 (8,400 acres) to 1994 (about 10,000 acres). The most significant increases occurred on the Clearwater National Forest in Idaho and the Flathead and Helena National Forests in Montana. Results from ground surveys suggest a population decline can be expected in many areas in 1995. The extensive fires experienced in the region in 1994 may predispose many trees to Douglas-fir beetle attack in 1995.

Region 2: Colorado, Wyoming

Host(s): Douglas-fir

Mortality along the Colorado Front Range continued to occur in small, widely scattered groups, often associated with older western spruce budworm defoliated trees. Aerial surveys for the Pike National forest estimated 2,474 acres infested and 4,124 fading trees. In the Gunnison zone, populations remained static at a low level. Aerial surveys of the San Isabel National forest found 4,349 acres of generally infested trees; aerial survey

on the San Isabel National Forest found 414 acres of low level infestations. On the Clarks Fork Ranger District of the Shoshone National Forest in Wyoming, tree mortality increased in 1994 by about 19% over 1993 figures. Nearly 5,000 Douglas-fir trees died in 1994 between Sunlight Basin and Crandall Ranger Station.

Region 3: Arizona, New Mexico

Host(s): Douglas-fir

Douglas-fir beetle–caused tree mortality decreased throughout the mixed conifer forest cover type regionwide from 1,160 acres in 1993 to 695 acres in 1994. In Arizona, mortality occurred on the Apache-Sitgreaves National Forests (50 acres), Coconino National Forest (90 acres), Coronado National Forest (150 acres), Kaibab National Forest (170 acres), and the Fort Apache Indian Reservation (10 acres). In New Mexico, mortality occurred on the Carson National Forest (125 acres), Cibola National Forest (40 acres), Gila National Forest (15 acres), and Navajo Indian Reservation (45 acres).

Region 4: Idaho, Utah, Wyoming

Host(s): Douglas-fir

Regionwide mortality decreased with 56,500 trees killed in 1994, a twofold decrease from 1993. Outbreaks were located on the Boise, Caribou, Sawtooth, and Payette National Forests. In Utah, tree mortality remained constant, with 6,700 trees killed in 1993 and 6,000 trees killed in 1994. The largest outbreaks are located on the Uinta and Wasatch-Cache National Forests. Smaller outbreaks are located on other national forests in Utah. Mortality on the Bridger-Teton National Forest in western Wyoming remained constant, with 6,600 trees killed in 1993 and 6,400 trees killed in 1994.

Region 5: Northern California

Host(s): Douglas-fir

Attacks by this beetle were limited, and often associated with drought, dwarf mistletoe infestions, and poor vigor associated with the presence of black stain and armillaria root disease.

Region 6: Oregon, Washington

Host(s): Douglas-fir

Douglas-fir beetle activity increased significantly throughout the region, from 50,600 acres averaging 0.60 tree/acre in 1993 to 73,700 acres with an average of 0.83 tree/acre in 1994. The Umatilla and Wallowa-Whitman National Forests experienced the most significant increases in observed activity. Decreases in activity were noted for the Willamette and Gifford Pinchot National Forests. The high levels of mortality on the Umatilla and Wallowa-Whitman National Forests are due, in part, to tree stress caused by repeated years of defoliation by western spruce budworm. High populations of Douglas-fir beetle and resultant host mortality in the Blue Mountains are expected to continue for the next few years.

Douglas-fir tussock moth,
Orgyia pseudotsugata

Region 1: Idaho, Montana

Host(s): Douglas-fir, spruce, true firs

Douglas-fir tussock moth populations remained at extremely low levels in 1994. No aerially visible defoliation was detected, nor were any larvae found at those sites that were sampled. Moth catches in pheromone traps were at record low levels in Idaho, and at very low levels in Montana. Populations are expected to remain quite low in 1995.

Region 2: Colorado

Host(s): Douglas-fir, Engelmann spruce

The outbreak detected in 1993 at West Creek, Pike National Forest, as predicted, expanded greatly in 1994 to 6,134 acres from 250 acres of heavy defoliation. Egg deposition was high in many areas, indicating that the population may expand in 1995, perhaps in excess of 20,000 acres. The current infestation is the largest on record for Colorado. The reasons for this can only be speculated on; however, since the exclusion of fire from the Front Range pine ecosystem, Douglas-fir has invaded sites historically occupied by ponderosa pine. This recent outbreak of the Douglas-fir tussock moth has been of greater intensity and covered larger areas than there are records for.

Region 4: Idaho, Montana, Utah

Host(s): Douglas-fir, true firs

In 1992, Douglas-fir tussock moth populations collapsed. No defoliation was observed in 1994.

Region 5: Northern California

Host(s): White fir

Populations remain at low, non-damaging levels.

Region 6: Oregon, Washington

Host(s): Douglas-fir, true firs

Aerial survey detected 46,000 acres of Douglas-fir tussock moth activity in 1993, most of which occurred on the Burns Ranger District of the Malheur National Forest. Detection of tussock moth related defoliation fell to 26,500 acres in 1994, with the vast majority once again occurring on the Burns Ranger District. Negligable amounts of defoliation are expected for 1995.

Elm spanworm,
Ennomos subsignarius

Region 9/Northeastern Area: New York, Pennsylvania

Host(s): American beech, aspen, black birch, black cherry, red maple, sugar maple, white ash

Elm spanworm has reached outbreak populations in New York and Pennsylvania, where 240,000 and 1,600,000 acres of hardwood forests were defoliated. The Allegheny National Forest in Pennsylvania conducted an aerial spray program on 55,762 acres to protect maple forests from damage caused by this insect.

Fall cankerworm,
Alsophila pometaria

Region 9/Northeastern Area: Maine, Maryland, New York, Pennsylvania

Host(s): American beech, boxelder, red oak, sugar maple, white ash, white oak

In Maryland and Pennsylvania, minimal defoliation occurred from this pest. Maine is expecting heavy defoliation in 1995. New York reported over 170,000 acres of defoliation by fall cankerworm. Suppression projects are planned for 1995 on the Seneca Indian Nation lands in New York and on state and private lands in Pennsylvania. Treatment is in conjunction with spraying for the forest tent caterpillar.

Fir engraver,
Scolytus ventralis

Region 1: Idaho, Montana

Host(s): Grand fir, subalpine fir

Fir engraver–infested stands increased somewhat in both Idaho and Montana in 1994. In 1993, 6,450 acres of infestation were mapped in northern Idaho. That increased to 7,063 acres infested in 1994. The largest concentrations of these beetles are found on the Nez Perce and Idaho Panhandle National Forests. A slight increase in the infestation was noted in Montana as well, up from 187 acres in 1993, to 318 acres in 1994. Most of the increase was on the Lolo National Forest. A continuing increase can be expected if the hot, dry conditions of 1994 persist.

Region 3: Arizona, New Mexico

Host(s): True firs

Tree mortality from fir engraver attacks was detected on 3,140 acres of susceptible host type in 1994 compared to 2,330 acres in 1993. Mortality on federal lands in Arizona included 135 acres on the Apache-Sitgreaves National Forests, 10 acres on the Coconino National Forest, 1,880 acres on the Kaibab National Forest, and 10 acres on the Fort Apache Indian Reservation. Mortality caused by these bark beetles occurred in New Mexico, included 75 acres on the Carson National Forest , 5 acres on the

Cibola National Forest, 5 acres on the Gila National Forest, and 1,020 acres on the Navajo Indian Reservation.

Region4: Idaho, Nevada, Utah, wyoming

Host(s): Grand fir, red fir, subalpine fir, white fir

Decreases in fir engraver activity were observed in Nevada and Idaho, but increases were observed in Utah. Regionwide, 394,700 trees were killed in 1993 compared to 180,500 trees in 1994. In Idaho, significant decreases in activity occurred on the Boise and Payette National Forests, and on adjacent state and private lands. Only 4,400 trees were killed in southern Idaho in 1994 compared to 67,200 trees in 1993. Conversely, in Utah fir engraver beetle activity increased with 86,600 trees killed in 1994 compared to 45,100 trees killed in 1993. Most activity was located on the Uinta National Forest, where 76,100 dead trees were observed. Elsewhere, mortality was observed on the Dixie, Fishlake, Manti-LaSal, and Wasatch-Cache National Forests. In Nevada, activity decreased from 281,000 trees killed in 1993 to 89,500 killed in 1994. Tree mortality is noted primarily on federal, state, and private lands in the Tahoe Basin area and adjacent areas of the Toiyabe National Forest. Fir engraver beetle activity was not observed on the Bridger-Teton National Forest in western Wyoming.

Region 5: California

Host(s): Red fir, white fir

The fir engraver remained the most significant forest insect in California. Large numbers of trees faded in northern California from attacks in 1993. Stands with mortality in excess of 50% were found in Lassen, Modoc, and Plumas Counties. Highest levels appear to be in areas that normally receive relatively low precipitation. Top-kill and mortality continued at low levels throughout most of the westside southern Sierra Nevada. However, high levels of mortality continued on the eastside in parts of the Lake Tahoe Basin and the Inyo National Forest (Mono County). White fir decline and mortality was reported from Thomas Mountain on the San Bernardino National Forest in southern California.

Region 6: Oregon, Washington

Host(s): True firs

Fir engraver activity decreased from 1993 reported levels. Regionally, reported levels dropped from 473,290 acres (an average of 1.25 trees/acre) in 1993 to 358,000 acres (an average of 0.68 tree/acre) in 1994. The Fremont National Forest had a reported decrease in acres affected from 284,000 in 1993 to approximately 208,000 acres in 1994. The most significant decrease in reported mortality associated with fir engraver occurred on the Rogue River National Forest (53,200 acres in 1993; 5,500 acres in 1994). Although an increase in acres affected was reported for the Winema, overall tree mortality declined from 1993 levels.

Insects: Native

Forest tent caterpillar, *Malacosoma disstria*

Region 9/Northeastern Area: Indiana, Maine, Maryland, New York, Ohio, Pennsylvania, Vermont

Host(s): Blackgum, elms, oaks, red oak, sugar maple, sweetgum, trembling aspen, white ash

In Maryland, about 4,400 acres of defoliation were caused by the forest tent caterpillar. New York reported 440,994 acres defoliated and Pennsylvania reported 156,913 acres defoliated. Ohio, Indiana, Maine, and Vermont also reported incidence of the caterpillar, but without measurable defoliation. Suppression projects were planned for 1995 on the Allegheny National Forest and state and private lands in Pennsylvania and on the Seneca Indian Nation lands in New York. The latter two projects are in conjunction with treatment for the fall cankerworm.

Jack pine budworm, *Choristoneura pinus*

Region 9/Northeastern Area: Michigan, Minnesota, Wisconsin

Host(s): Jack pine

In Michigan, approximately 18,000 acres were defoliated by the jack pine budworm. Populations collapsed throughout the Upper Peninsula. In Minnesota, jack pine budworm populations peaked in 1993, causing light defoliation this year on approximately 47,000 acres. In Wadena County, Minnesota, building populations were detected. In Wisconsin, populations of jack pine budworm decreased statewide from 1993 levels. Approximately 80,000 acres were defoliated by the budworm. The only significant defoliation (approximately 21,000 acres of the total for Wisconsin) occurred on the Washburn District of the Chequamegan National Forest.

Jeffrey pine beetle, *Dendroctonus jeffreyi*

Region 4: Nevada

Host(s): Jeffrey pine

Jeffrey pine beetle activity declined on the Toiyabe National Forest, with 11,800 trees killed. Significant tree mortality continues to occur in the Tahoe Basin area on Forest Service, state, and private lands. Less widespread activity is present throughout other areas on the Toiyabe National Forest.

Region 5: California

Host(s): Jeffrey pine

Mortality caused by Jeffrey pine beetle attacks on drought-stressed trees has been increasing for several years over much of northern California as far south as the eastside of the Tahoe National Forest. High levels of mortality also are found in the Lake Tahoe Basin and the Inyo National

Forest. Mortality in the San Bernardino Mountains in southern California was low.

Lodgepole needleminer, *Coleotechnites milleri*

Region 5: California

Host(s): Lodgepole pine

Significant needleminer activity was observed in Yosemite National Park and Stanislaus National Forest. Very high larval populations were found at two plots, May Lake and Omstead #1. Heavy-to-complete defoliation was anticipated at these two plots, with the result that most of the larvae present will fail to reach maturity in 1995. The heavily used areas around Tenaya Lake and Tuolumne Meadows continued to be free of visible defoliation. However, the extensive areas of defoliation in several back country locations reported in 1993 were again visible and two areas of defoliation were visible along Highway 120 west of Tenaya Lake.

Mountain pine beetle, *Dendroctonus ponderosae*

Region 1: Idaho, Montana

Host(s): Lodgepole pine, ponderosa pine, other pines

Mountain pine beetle populations continued their decline in most host species throughout the Northern Region. The 1994 total, for all host species, was 22,663 acres infested. This resulted in about 70,000 killed trees. These are the lowest annual figures recorded in the region in the past quarter century. Acres infested are less than half the nearly 51,000 acres recorded in 1993. About 19,000 of the infested acres are in Montana; the remainder are in Idaho. Though beetle populations are currently low, much susceptible lodgepole pine remains in the region. As long as suitable hosts are available, the threat of building infestations persists. However, it is likely that a further decline of the population will occur for the next few years.

Region 2: Colorado, South Dakota, Wyoming

Host(s): Limber pine, lodgepole pine, ponderosa pine

The infestation at Laramie Peak, Wyoming, is now at endemic levels. The small infestation that was reported in 1992 in lodgepole pine near Lake Granby, Colorado, on the Arapaho National Forest, remains endemic. Very few newly attacked trees could be found during the reconnaissance of the area. Only 264 acres were detected during aerial surveys on the Pike National Forest. No major outbreaks were reported in the Gunnison zone. Aerial survey of the San Juan and San Isabel National Forests revealed 763 and 4 acres, respectively, of lightly infested stands. Tree mortality declined significantly for a second year in a row in the central Black Hills of South Dakota. The 1993 to 1994 reduction was 48%. The epidemic near Bear Mountain continued to collapse and few adults emerged. About 3,000

ponderosa pine were killed by bark beetles in the Black Hills of South Dakota and Wyoming; this was the lowest level of damage reported in years. On the Bighorn Nnational Forest in Wyoming, mortality of limber pine appeared to decline in Tensleep Canyon as well.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Tree mortality resulting from mountain pine beetle attacks increased (from 1,400 acres in 1993 to 1,990 acres) in 1994. Mountain pine beetle killed trees were detected on the Kaibab National Forest (210 acres), Arizona; and the Carson National Forest (130 acres), Santa Fe National Forest (661 acres), and Navajo Indian Reservation (990 acres), New Mexico.

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Lodgepole pine, ponderosa pine, whitebark pine

Trees killed by mountain pine beetle attack decreased from 44,600 in 1993 to 24,200 trees in 1994. In Utah, 19,100 trees were killed during 1994, while 11,500 trees were killed in 1993. Most mortality occurred in ponderosa pine. The largest outbreak is located on the Dixie National Forest, where 11,600 trees were killed. Smaller outbreaks were located on all other national forests in Utah. In Idaho, a significant reduction in activity occurred, with only 4,800 trees killed in 1994 compared to 41,300 during 1993. Mortality occurred in both lodgepole and ponderosa pine. Decreases occurred on all national forests except the Caribou National Forest, where tree mortality levels remained constant. The largest outbreak in southern Idaho contined in the Sawtooth National Recreation Area on the Sawtooth National Forest. On the Bridger-Teton National Forest in western Wyoming, tree killing by mountain pine beetle decreased, with only 300 trees observed in 1994. The cool, wet weather of 1993 evidently affected beetle populations in 1994. Attacks were reported a month earlier than expected in 1994, indicating that adults successfully overwintered in 1993–94.

Decreases in whitebark pine mortality attributed to mountain pine beetle activity occurred Regionwide during 1994. Small, isolated infestations were located on national forests in Idaho and on the Bridger-Teton National Forest in western Wyoming.

Region 5: Northern California

Host(s): Lodgepole pine, Ponderosa pine, Sugar pine

Activity was limited in coastal areas, but sugar pine mortality caused by drought and mountain pine beetle continued or increased across northern California. Additional large, overstory sugar pines were killed as in previous years, but there was also mortality in the relatively thrifty 20- to 80-year age class. Lodgepole pine mortality stabilized in some stands because of the previous loss of the more susceptible trees. Mountain pine beetle activity was generally low throughout the Sierra Nevada Range. However, mortality of lodgepole pine was high in the Donner Memorial State Park (Nevada County) and continued in the Lake Tahoe Basin and the Lakes Basin near Mammoth Lakes (Mono County).

Region 6: Oregon, Washington

Host(s): Jeffrey pine, lodgepole pine, ponderosa pine, sugar pine, western white pine, whitebark pine

Acres affected by mountain pine beetle decreased from 546,000 acres (an average of 1.44 trees/acre) in 1993 to 238,000 acres (an average of 2.04 trees/acre) in 1994. Increased activity in the western white pine host type was detected in the North Cascades National Park and the Deschutes and Winema National Forests. Affected acres in whitebark pine on the Okanogan and Wenatchee National Forests doubled from those reported in 1993.

Pandora moth, *Coloradia pandora*

Region 6: Oregon

Host(s): Lodgepole pine, Ponderosa pine

A special pandora moth survey conducted June 15, 1994, detected over 369,000 acres of defoliation by this insect. Defoliation intensities in the moderate to heavy categories accounted for 58 percent of the acres reported. The affected area was west and south of the area defoliated in 1992 and was centered near the community of La Pine, Oregon. Defoliation was evident along Highway 31 from La Pine to milepost 20, along Highway 97 from Sunriver to Gilchrist, and westward to the foothills of the Cascade Mountains. Both ponderosa and lodgepole pines were affected but they appeared to recover and produce new foliage shortly after the summer defoliation. Tree mortality has not been noted thus far in the defoliated areas. Several locations were examined for presence of the naturally occurring virus which, to date, had been fairly rare in the previous four larval generations of the pandora moth. In 1994, this virus was very evident throughout the defoliated area and dead larvae with viral symptoms were common. Nonetheless, many insects pupated successfully within the same areas. A small-scale study is currently underway to determine the level of adult survival and to predict moth population densities for the 1995 season.

Pine engraver, *Ips* spp.

Region 1: Idaho, Montana, Wyoming

Host(s): Lodgepole pine, ponderosa pine

As determined by regular aerial survey, *Ips pini* populations were down considerably in the region from 1993 (about 8,000 acres) to 1994 (about 2,100 acres). Ordinarily, the newly faded trees that are reported as killed were actually infested and killed the year prior to our detecting and reporting them. Hence, the decline in "red" trees in 1994 reflects the reduction in attacks in 1993, a wet, cool summer. Because 1994 was an unusually hot, dry year, great deal of ips activity will show up as dead trees in 1995.

Insects: Native

Region 2: Colorado, South Dakota, Wyoming

Host(s): Lodgepole pine, ponderosa pine

Small pockets of top killing and tree mortality by *Ips pini* continued throughout the Black Hills on ponderosa pine and was locally abundant in some spots. These beetles continue to kill ornamental pine and spruce along the Front Range, especialy in the Denver area.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Ips beetle–killed trees were detected on 4,135 acres of the ponderosa pine forest cover type in 1994 compared to 1,630 acres in 1993. In Arizona, mortality occurred on the Apache-Sitgreaves National Forest (155 acres), Coconino National Forest (750 acres), Coronado National Forest (10 acres), Kaibab National forest (425 acres), Prescott National Forest (200 acres), Tonto National Forest (345 acres), San Carlos Indian Reservation (395 acres), and Fort Apache Indian Reservation (600 acres). In New Mexico, mortality occurred on the Carson National Forest (125 acres), Cibola National Forest (320 acres), Gila National Forest (85 acres), and Santa Fe National Forest (725 acres).

Region 4: Idaho, Navada, Utah

Host(s): Lodgepole pine, ponderosa pine

Increases of ground detections of pine engraver (*I. pini*) occurred on the Boise and Payette National Forests in southern Idaho. Activity is often associated with western pine beetle. In Utah, populations were found in slash of ponderosa and lodgepole pine.

Region 5: California

Host(s): Pines

In general, engraver beetles were found in pines that were under attack by other bark beetles. However, on the eastside of the Sierra Nevada in Mono Couty, California, and Douglas County, Nevada, increasing mortality of pinyon pine probably was associated with the pinyon ips, *I. confusus*.

Region 6: Oregon, Washington

Host(s): Ponderosa pine

Aerially detected pine engraver activity decreased for the first time in 4 years. Over 23,000 acres were reported in 1993 compared to only 5,370 acres in 1994. Significant decreases were reported on the Umatilla, and Wallowa-Whitman National Forests and the Colville Indian Reservation. Over 2,200 acres of pine engraver activity were mapped over the Glenwood reporting area in Washington; there were no acres reported for this area in 1993.

Region 8: Regionwide

Host(s): Southern pines

In 1994, mortality resulting from pine engraver beetles (*I. avulsus*, *I. calligraphus*, *I. grandicollis*) was about average throughout region 8. The

hot dry conditions led to high activity in Alabama, Mississippi, South Carolina, Texas, and eastern Oklahoma.

Roundheaded pine beetle, *Dendroctonus adjunctus*

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Roundheaded pine beetle caused tree mortality on 24,840 acres of host type in 1994 compared to 34,170 acres in 1993. In Arizona, mortality occurred on the Coronado National Forest (2,130 acres), and in New Mexico on the Lincoln National Forest (9,990 acres) and the Mescalero Indian Reservation (12,720 acres).

Southern pine beetle, *Dendroctonus frontalis*

Region 8: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia

Host(s): Southern pines

Compared to 1993, the number of southern pine beetle (SPB) infestations in region 8 decreased by 76 percent, and the number of affected acres declined by 50 percent. The number of beetle spots went down in every state except South Carolina. Due in part to cold winter temperatures, the record-setting SPB population levels in Virginia in 1993 plummeted in 1994. Beetle activity also decreased dramatically in Texas.

The two states with the highest SPB populations were Alabama and Mississippi. Activity in Alabama was highest in the west central section, while in Mississippi activity was centered on the Homochitto National Forest in the southwestern corner. Beetle populations were relatively high in the Piedmont of South Carolina and Georgia as well.

The most unique situation related to SPB occurred in Florida, where beetle populations increased to outbreak levels within the city limits of Gainesville. Over 250 spots were detected affecting hundreds of residential landowners. The Florida Division of Forestry worked closely with county and city officials to control these SPB infestations. The last-documented SPB outbreak within the Gainesville area occurred in the mid-1940's.

SPB populations in the wildernesses within the National Forests in Texas decreased significantly in 1994. Turkey Hill Wilderness was the only area that had any activity at all. Due to the reduced beetle activity, fewer red-cockaded woodpecker cavity trees were attacked in 1994.

Insects: Native

Region 9/Northeastern Area: Delaware, Maryland, West Virginia

Host(s): Loblolly pine, pitch pine, Virginia pine

Southern pine beetle populations declined in Maryland. Nearly 3,400 acres of Virginia pine mortality were detected in West Virginia. Southern pine beetle caused tree mortality is increasing in the State.

Spruce beetle, *Dendroctonus rufipennis*

Region 1: Idaho, Montana

Host(s): Engelmann spruce

Spruce beetle populations remained at virtually endemic levels throughout the region in 1994. In northern Idaho, only 108 acres were mapped—most as small and scattered clusters of trees on the Idaho Panhandle National Forest. In western Montana, 157 infested acres were recorded in 1994 compared to 526 acres in 1993. Small and widely scattered groups of dead trees were observed on the Flathead, Gallatin, and Lewis and Clark National Forests

Region 2: Colorado, Wyoming

Host(s): Engelmann spruce

Spruce beetle activity was negligible despite large quantities of suitable blow-down host material in the Bighorn Mountains.

Region 3: Arizona, New Mexico

Host(s): Spruce

Spruce beetle–caused tree mortality decreased from 1,180 acres in 1993 to 760 acres in 1994. Mortality was detected on the Coconino National Forest (10 acres), Kaibab National Forest (45 acres), and the Fort Apache Indian Reservation (30 acres) in Arizona; and the Cibola National Forest (40 acres), Gila National Forest (85 acres), Santa Fe National Forest (175 acres) and Navajo Indian Reservation (375 acres) in New Mexico.

Region 4: Idaho, Utah, Wyoming

Host(s): Spruce

Mortality from spruce beetle infestation decreased during 1994, with 45,200 trees killed compared to 58,200 in 1993. This decrease was attributed to a decline in host type on the Payette National Forest due to recent outbreaks and extensive wildfire in infested areas. No significant mortality was reported on any other forests in southern Idaho. In Utah, 35,700 trees were killed, and activity increased on the Fishlake and Manti-LaSal National Forests and decreased on the Dixie National Forest. No significant mortality was observed on the Bridger-Teton National Forest in western Wyoming.

Region 5: Northwestern California

Host(s): Sitka spruce

No significant activity was reported.

Region 6: Oregon, Washington

Host(s): Engelmann spruce

No significant activity was reported in 1994.

Region 10: Alaska

Host(s): Lutz spruce, Sitka spruce, white spruce

Spruce beetles continue to affect vast areas in Alaska. Beetle infestations decreased slightly in 1994 by nearly 80,000 acres; however, 641,026 acres of newly infested and on-going infestations were aerially detected. Although most areas are in slight decline, other infestations have collapsed. These decreases are offset somewhat by other areas of significant increases in southwestern and interior Alaska. The two spruce beetle outbreaks in southeast Alaska (Glacier Bay National Park and Haines) declined significantly. Many ownerships are being affected, with more than three-quarters of the infestations occurring on state and private lands. There are numerous impacts associated with these infestations, including (1) loss of merchantable value of killed trees, (2) long-term ecosystem conversion, (3) impacts to wildlife habitat, (4) impacts to scenic quality, (5) fire hazard, and (6) impacts to watersheds/fisheries. These infestations are primarily located in south-central and interior Alaska.

Spruce budworm, *Choristoneura* spp.

Region 9/Northeastern Area: Maine, Michigan, Minnesota, New York, Vermont, Wisconsin

Host(s): Balsam fir, spruce

In Minnesota, spruce budworm (*C. fumiferana*) caused about 770,000 acres of defoliation on state lands, the Superior and Chippewa National Forests, and the Voyager's National Park. In New York, 42 acres of white spruce in Yates and Ontario Counties experienced defoliation. Moth catch remained very low in Maine and Vermont, and no significant populations of spruce budworm were detected. The Nicolet National Forest in Wisconsin reported 964 acres of defoliation by spruce budworm. In Michigan, approximately 6,800 acres were defoliated on the Isle Royale.

Region 10: Alaska

Host(s): Sitka spruce, Lutz spruce, white spruce

Areas of spruce defoliation attributed to spruce budworms (*C. fumiferana, C. orae,* and *C. biennis*) did not decline as expected. On the contrary, the number of acres defoliated rose sharply from 33,000 acres in 1993 to 232,477 acres in 1994. The largest area of activity (150,000 acres) was along the Tanana River and the confluence of the Tanana and Yukon Rivers in interior Alaska. Impact studies were initiated in interior Alaska. Budworm populations are expected to remain at static levels in 1995.

Western balsam bark beetle, *Dryocoetes confusus*

Region 4: Idaho, Utah

Host(s): Subalpine fir

A complex of western balsam bark beetle and disease pathogens resulted in the death of 272,900 trees throughout the region. Currently, this complex is the most widespread cause of visible mortality of subalpine firs in the region. In Idaho, 61,100 trees were killed during 1994 compared to 141,100 trees in 1993. Large areas of mortality are located on the Boise, Caribou, Payette, and Targhee National Forests. In Utah, activity increased, with 157,300 trees killed in 1994. Extensive mortality was observed on every national forest except the Ashley. Activity decreased in western Wyoming—54,500 trees were killed in 1994 compared to 124,300 trees in 1993.

Western blackheaded budworm, *Acleris gloverana*

Region 10: Alaska

Host(s): Mountain hemlock, western hemlock, Sitka spruce

The blackheaded budworm outbreak affected vast areas of southeast Alaska for the fourth consecutive year. Over 193,000 acres of hemlock and spruce defoliation was noted in 1994, down approximately 65,000 acres from observations in 1993. Budworm defoliation has been most common in highly productive, old-growth stands, at elevations less than 1,000 feet. Defoliation was noted on the Tongass National Forest, on lands managed by the Bureau of Land Management, Alaska Native corporations, and the state of Alaska, and within several communities. Top-kill was evident in some areas, following 3 consecutive years of heavy defoliation. Impact studies were initiated in second-growth stands on the Tongass National Forest. Some mortality and growth loss is occurring. The major impact to date, however, has been loss of aesthetic quality in and around communities dependent upon tourism.

Western hemlock looper, *Lambdina fiscellaria lugubrosa*

Region 6: Oregon, Washington

Host(s): Douglas-fir, Pacific silver fir, Sitka spruce, western hemlock

Defoliation caused by the western hemlock looper was detected on 2,130 acres of North Cascades National Park and on 20,400 acres of Mt. Baker-Snoqualmie National Forest, down from over 45,000 acres reported in 1993.

The majority of the defoliation was detected on the Darrington and Mt. Baker Ranger Districts.

Western pine beetle, *Dendroctonus brevicomis*

Region 1: Idaho, Montana

Host(s): Ponderosa pine

The area of ponderosa pine stands infested by the western pine beetle declined in both northern Idaho and Montana in 1994. The infested area in Idaho declined from 3,881 acres in 1993 to 2,111 in 1994. Almost half of this was on the Nez Perce Indian Reservation and the Nez Perce National Forest. Elsewhere, infestations were small, scattered groups throughout the ponderosa pine stands. The decline in Montana was not as significant, from 1,170 acres in 1993 to 985 in 1994. Most of these areas of infestation were scattered on the Bitterroot and Lolo National Forests.

Region 2: Colorado

Host(s): Ponderosa pine

No significant activity reported in 1994.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Western pine beetle–killed trees were detected on 2,170 acres in 1994 compared to 2,300 acres of host type in 1993. Mortality on federal lands in Arizona included 735 acres on the Apache-Sitgreaves National Forests, 190 acres on the Coconino National Forest, 100 acres on the Coronado National Forest, 130 acres on the Kaibab National Forest, 35 acres on the Tonto National Forest, 60 acres on the Fort Apache Indian Reservation, 25 acres on the San Carlos Apache Indian Reservation, and 20 acres on the Hualupai Indian Reservation. In New Mexico, mortality from these bark beetles occurred on 185 acres of the Cibola National Forest and 690 acres of the Gila National Forest.

Region 4: Idaho

Host(s): Ponderosa pine

Significant decreases in western pine beetle activity occurred on the Boise, Payette, and Sawtooth National Forests in southern Idaho. Approximately 6,300 trees were killed in 1994 compared to 18,500 in 1993. Pine engraver beetle activity was frequently associated with western pine beetle infestation.

Region 5: California

Host(s): Coulter pine, ponderosa pine

Ponderosa pine mortality increased from west to east across northern California and was high in some areas that rarely show much mortality, such as the Sacramento River Canyon. In northeastern California, mortality

was most evident in the predominant overstory trees, along with some small groups of large pole and small sawtimber-size trees. In the westside pine and mixed-conifer areas of the southern Sierra Nevada, pine mortality associated with the western pine beetle continued to decline relative to the high levels experienced between 1989–1992. Mortality of Coulter and ponderosa pine was low in southern California, presumably because of favorable rainfall patterns in the winter of 1993–1994.

Region 6: Oregon, Washington

Host(s): Ponderosa pine

Western pine beetle activity decreased in both large and pole-sized ponderosa pines throughout the region. Approximately 29,600 large trees were reported killed in 1994, compared to over 41,100 trees killed in 1993. Mortality in smaller, pole-sized trees decreased from 191,500 trees in 1993 to 38,200 trees in 1994.

Notable decreases in large-tree mortality occurred on the Malheur, Ochoco, and Wallowa-Whitman National Forests. A significant increase in large-tree mortality was reported on the Fremont National Forest.

With the exception of a slight increase in mortality on the Okanogan National Forest, mortality in pole-sized ponderosa pines decreased across the region; most significant decreases occurred on the Rogue River, Siskiyou, and Colville National Forests, as well as the Colville, Yakima, and Spokane Indian Reservations.

Increased populations of bark beetles can be expected in the coming years in areas associated with the extensive fires that occurred over many areas of Washington and Oregon during the summer of 1994. Unmanaged, dense stands will be more susceptible.

Western spruce budworm, *Choristoneura occidentalis*

Region 1: Idaho, Montana

Host(s): Douglas-fir, Engelmann spruce, true firs

In 1993, budworm populations collapsed from an average of about 1.7 million acres of detectable defoliation per year to only about 45,000 acres. This was attributed largely to the unusually heavy precipitation levels, accompanied by cool temperatures, that occurred in 1993. Despite a return to more normal precipitation and temperatures in 1994, the decline in defoliation continued, totaling about 2,000 acres. This occurred on the Deerlodge National Forest in Montana. If climatic conditions remain favorable for budworm survival and development, we expect populations to slowly rebound in succeeding years.

Region 2: Colorado, Wyoming

Host(s): Douglas-fir, Engelmann spruce, subalpine fir, white fir

Aerial surveys on the Pike National Forest detected 101,761 acres of older budworm mortality. New defoliation was negligible. Defoliation of mixed conifer and subalpine fir continued in the Gunnison zone in 1994. Most of the defoliation appeared on the Salida District of the San Isabel National Forest, on the Creede and Del Norte Districts of the Gunnison National Forests, and on the Rifle District of the White River National Forest. Aerial survey of the San Isabel National Forest revealed 9,690 acres of old heavy mortality. Moderate levels of defoliation were visible on more than 1,000 acres in the northern Bighorn Mountains of Wyoming.

Region 3: Arizona, New Mexico

Host(s): Douglas-fir, spruce, true firs

This was the second consecutive year that western spruce budworm defoliation levels were undetectable in Arizona. In New Mexico, defoliation increased almost four and one-half times, from 66,400 acres in 1993 to over 369,170 acres in 1994. On federal lands, defoliation occurred on the Carson National Forest (245,230 acres), Cibola National Forest (7,320 acres), Santa Fe National Forest (23,040 acres), Jemez Pueblo Indian Reservation (2,720 acres), Picuris Pueblo Indian Reservation (1,160 acres), Santa Clara Pueblo Indian Reservation (2,440 acres), and Taos Pueblo Indian Reservation (15,080 acres). Defoliation on non-industrial state and private lands in northern New Mexico totaled 72,180 acres of susceptible mixed conifer host type.

Region 4: Idaho

Host(s): Douglas-fir, true firs

For the first time since the early 1960's, no visible defoliation from western spruce budworm was observed anywhere in the region.

Region 6: Oregon, Washington

Host(s): Douglas-fir, Engelmann spruce, true firs, western larch

Areas of visible defoliation continued to decline regionwide, from 331,500 total acres reported for 1993 to under 123,000 acres for 1994. This represents the fourth consecutive year of declines in detected activity. Over 68 percent of the defoliation was detected in Washington, with 95 percent of that being classified in the light effects category.

Populations in the Blue Mountains have declined to low levels, which resulted in very little detectable defoliation.

The Yakima Indian Reservation and the adjoining portion of the Gifford Pinchot National Forest experienced an increase in reported acres of activity (60,100 in 1993; 73,700 acres in 1994).

Areas that have sustained repeated defoliation since the late 1980's may continue to experience some mortality.

Insects: Nonnative

A leafhopper,
Sophonia rufofascia

Region 5: Hawaii—Oahu (1987), Hawaii (1989), Kauai (1990), Lanai (1991), Maui (1992)

Host(s): Numerous, including native plants

Thus far 287 species (51 endemics) in 83 plant families are being affected. This introduced insect is a suspect in the die-off of Uluhe fern and other plant species such as *Acacia koa*. Investigations continue on the relevance of mycoplasma-like agents found in some host species.

Balsam woolly adelgid,
Adelges piceae

Region 1: Idaho

Host(s): Grand fir, subalpine fir

Balsam woolly adelgid populations continue to expand and intensify at many locations in northern Idaho. Precise acres infested in 1994 are unknown because some of the outbreak areas were not aerially surveyed. Areas of greatest damage are on the Nez Perce, Clearwater, and Idaho Panhandle National Forests. Significant mortality continues in larger subalpine fir, but some regeneration of both fir species are being killed. In some areas, mortality of the regeneration is as high as 75 percent.

Region 6: Oregon, Washington

Host(s): True firs

Balsam woolly adelgid activity was observed on 18,400 acres in Washington in 1994. Although there was a slight increase in the acres reported in 1994, the total number of trees killed decreased from 10,600 in 1993 to approximately 4,300 in 1994. Mt. Baker–Snoqualmie National Forest and the Olympic National Park had the majority of the reported activity.

Region 8: North Carolina, Tennessee, Virginia

Host(s): Fraser fir

Fraser fir has a limited range and occurs predominantly on the highest mountains of the Southern Appalachians. This forest type occurs in pure stands on the highest peaks or in a mixture with red spruce at lower elevations. Since the introduction of the balsam woolly adelgid, 64,700 acres of Fraser fir have been affected. The insect prefers larger fir trees, which has led to the demise of almost all mature host trees within the affected areas. Adelgid populations were high again in 1994.

Region 9/Northeastern Area: Maine, West Virginia

Host(s): Balsam fir

In Maine, two reports of damage to high-value Christmas tree and ornamental stock were reported in Kennebec and Lincoln Counties, respec-

tively. In Tucker County, West Virginia, four previously uninfested stands were found to be infested with balsam woolly adelgid.

Blue gum psyllid, *Ctenarytaina eucalypti*

Region 5: California

Host(s): *Eucalyptus pulverulenta, E. globulus*

First found in 1991, this psyllid is now widespread. The most recent finding was in Humboldt County, and the insect now occurs in all coastal California counties except Del Norte. Infestations were significantly lower in 1994 in areas where the primary parasitoid wasp *Psyllaephagus pilosus* Noyes (Encyrtidae) was introduced in 1993. The parasitoid appears to be spreading rapidly to other nearby locations and counties.

Common European pine shoot beetle, *Tomicus piniperda*

Region 9/Northeastern Area: Illinois, Indiana, Michigan, New York, Ohio, Pennsylvania

Host(s): Scotch pine

New counties were reported in all states where this beetle is currently known to occur. In Illinois, 10 counties are infested with pine shoot beetle. In Connecticut, a statewide survey did not find any pine shoot beetles.

Gypsy moth (Asian), *Lymantria dispar*

Region 8: North Carolina

Hosts: Alder, larch, oak, poplar, willow, other hardwoods and some evergreens

In 1993, adult Asian gypsy moths with their characteristic flying females were accidentally released at the Military Ocean Terminal at Sunny Point, North Carolina. Hundreds of male moths—European strain, Asian strain, and hybrids—were captured in pheromone traps after the accidental introduction. A cooperative eradication project with the North Carolina Department of Agriculture and the USDA Animal and Plant Health Inspection Service (APHIS) was carried out in 1994. Some 143,000 acres were treated twice with *Bacillus thuringiensis* (*Bt*) and with Gypchek applied to sensitive areas. The Asian gypsy moth could cause more serious economic and environmental consequences than the European strain because of its wider range of host species and potential to spread more rapidly with flying females. A follow-up treatment is planned in 1995.

Gypsy moth (European), *Lymantria dispar*

Region 1: Idaho, Montana, North Dakota, Wyoming

Host(s): Hardwoods

Cooperative detection monitoring for the gypsy moth with USDA APHIS, and State Deptsments of Agriculture, Forestry and Lands continued in 1994. A network of strategically located pheromone-baited traps were placed throughout all states in region 1. In 1994, two gypsy moths were captured in Coeur d'Alene, Idaho, and one moth was caught at Mammoth, in Yellowstone National Park, Wyoming.

Region 2: Colorado, Nebraska, South Dakota, Wyoming, Kansas

Host(s): Hardwoods

In 1994, no gypsy moths were caught in traps deployed in National Forest System, National Park Service, and Bureau of Land Management campgrounds within the Rocky Mountain Region in Colorado, South Dakota, and Wyoming or at the Air Force Academy in Colorado Springs, Colorado. Multiple trap catches were reported in Aurora and Lakewood (Denver metro area). In Nebraska, 73 moths were caught in detection traps on private lands in Buffalo, Douglas, Lancaster, Lincoln, Platte, Sarpy, and Washington Counties. Moths were introduced in 1994 on four separate shipments of infested nursery stock from Michigan. Moths, egg masses, larvae, and pupae were also found in Bellevue, Nebraska, resulting from the 1992 military move-in from Michigan. In South Dakota, 11 moths were caught in delimitation and detection traps located on private lands in Pennington, Meade, and Union Counties. Gypsy moths likely arrived on tourist vehicles and infested nursery stock. In Wyoming, two moths were caught within the Rocky Mountain Region on private lands in Albany and Park Counties.

Region 4: Utah

Host(s): Various deciduous species

This was the sixth year of the Utah Gypsy Moth Eradication Project. No insecticide treatment was done in 1994. Only one moth was caught in the Salt Lake Valley. One other moth was caught in the region.

Region 5: California

Host(s): Many kinds of trees and ornamentals

Approximately 21,000 traps captured ten moths in nine counties. None were associated with "move-ins" from infested areas of the northeastern United States. Therefore, these 10 areas will be intensively trapped during the 1995 season.

Region 6: Oregon, Washington

Host(s): Apple, oaks, sweetgum, other hardwoods

Although no defoliation has been observed in either state, pheromone traps continue to catch moths. These catches represent new introductions or populations not completely eradicated by the eradicative treatments.

In Washington, two eradication projects totaling 18 acres were conducted using a ground application of *Bacillus thuringiensis* (*Bt*). Gypsy moth survey in 1994 resulted in trap catches of 171 individuals. Of those so far typed, seven have been identified as the central Siberian strain of the Asian gypsy moth; the remainder were identified as the European strain. Eradication projects at Oakbrook (Pierce County) and Anacortes Port (Skagit County) are planned for 1995. The science panel has also recommended an eradication project in the Puyallup area, where two male moths were trapped and identified as the central Siberian strain.

In Oregon, eradication projects were conducted in Multnomah and Clackamas counties. Two ground applications of *Bacillus thuringensis* (*Bt*) were used on 8.25 acres (7 acres in Clackamas County and 1.25 acres in Multnomah County) acres and three aerial applications were made on 270 acres in Carver (Clackamas County). Thirty-six moths were trapped in Oregon, all have been identified as the European strain. Eradication projects at Jacksonville (ground application of *Bt*) and Veneta (aerial applications of *Bt*) are planned for 1995.

It is expected that new introductions will continue as long as gypsy moth populations in the East persist and people move from the generally infested area to the Pacific Northwest.

Region 8: Arkansas, Georgia, North Carolina, Tennessee, Virginia

Host(s): Apple, oaks, sweetgum, other hardwoods

Defoliation occurred on 452,475 acres of host type in 1994, compared to 589,000 acres in 1993. Virus and fungal (*Entomophaga maimaiga*) infections again affected populations over the infested portions of Virginia. Defoliation on federal lands included 165,922 on the George Washington National Forest and 101,408 acres on other federal lands. Treatments within the quarantine area covered 112,068 acres, while 82,354 acres were treated in 1993. Treatments are mainly limited to forested residential areas to reduce the impact to the visual or aesthetic benefits of the trees. The average rate of spread of the gypsy moth along the expanding front Virginia is 8 to 12 miles per year. In North Carolina and Virginia, 34,309 acres were treated to suppress low-density populations of gypsy moth as part of the Gypsy Moth Slow-the-Spread Pilot Project.

In region 8, isolated European gypsy moth infestations outside of the quarantine area were treated in Arkansas, North Carolina, and Tennessee. In Arkansas, 25,000 acres of private land were treated. In North Carolina, two isolated infestations totaling 1,166 acres were treated. In Tennessee, two isolated infestations totaling 7,855 acres were treated. Post-eradication trapping indicated that the insect had spread beyond this original infestation. Follow up treatment is proposed for 1995.

Male moths were trapped in all states regionwide.

Region 9/Northeastern Area: Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin

Host(s): Aspens, gray birch, northern red oak, red maple, white oak, other oaks

No defoliation was detected by aerial survey in Connecticut. Defoliation increased in Delaware, where damage was reported on 60,728 acres. Illinois trapped a total of 4,672 moths indicating an increase in the last 4 years. A record number of moths were detected in Indiana's mass trapping program. Maine reported a total of 1,706 acres of defoliation, all of them in York County. Maryland reported 93,147 acres of gypsy moth defoliation in 13 counties. In Massachusetts, gypsy moths defoliated 76,698 acres and killed trees on about 2,900 acres. Populations are expected to increase. Michigan reported 97,287 acres of gypsy moth defoliation. In Minnesota, detection trapping caught a record number, 349 moths in 24 counties. Missouri continued to report male moth catches in 1994. In New Hampshire, the trend for gypsy moth is down, with only 8,110 acres of defoliation. New Jersey reported 17,856 acres of defoliation. In Ohio, defoliation was down to only 100 acres from 600 acres the previous year. Pennsylvania reported 17,957 acres of gypsy moth defoliation. Rhode Island reported 430 acres of defoliation in Newport County. In Vermont, populations remain low, with no defoliation detected and none expected in 1995. West Virginia reported 53,417 acres of defoliation. Wisconsin's trapping program produced a total of 9,599 male moths.

Hemlock woolly adelgid, *Adelges tsugae*

Region 8: Virginia

Hosts: Hemlock

The hemlock woolly adelgid was first reported in the United States in 1920 on the West Coast. This adelgid was first reported from the East Coast near Richmond, Virginia in 1950. The insect has successfully colonized eastern hemlock, killing trees within 3 to 5 years. The hemlock woolly adelgid threatens the entire range of eastern hemlock. Most of the hemlock type in Virginia is generally infested, except for southwestern counties; decline and mortality are extensive. Much of the hemlock resource is located in riparian areas and makes the impact of this insect pest significant and devastating.

Region 9/Northeastern Area: Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia

Host(s): Eastern hemlock

In Connecticut, hemlock woolly adelgid occurs in 147 of 169 towns. This is up from 131 towns in 1993 and 129 towns in 1992. In West Virginia, 7 counties are now infested with hemlock woolly adelgid. In New York, some mortality has occurred at the Bayard Cutting Arboretum. In Massachusetts, two new infestations have been located in Bristol and Hampshire Counties. Ten counties in Maryland continue to have hemlock woolly adelgid present but no mortality in native stands has occurred; however, mortality may be occurring in ornamental hemlocks in suburban Washington, DC, and Baltimore, Maryland, counties. New Hampshire surveyed 60 plot locations and found no evidence of hemlock woolly adelgid. Although

the adelgid has been found statewide in Rhode Island, the insect has only now been found in natural stands in the northwestern part of the state; previously, the adelgid was only found on scattered ornamentals and yard trees. Hemlock woolly adelgid has not been found in Maine. Since 1991, no hemlock woolly adelgids have been observed in Vermont.

Pear thrips, *Taeniothrips inconsequens*

Region 9/Northeastern Area: New York, Ohio, Pennsylvania, Vermont

Host(s): Sugar maple

Pear thrips defoliation increased in Ohio to 1,760 acres from 200 acres in 1993. In New York, the 600,000 acre infestation of 1993 collapsed and no damage was found in 1994. Defoliated acres declined substantially in Pennsylvania and Vermont. In Pennsylvania, 335 acres were reported as compared to 76,000 acres in 1993. Vermont reported very low pear thrips defoliation after reporting 83,000 acres defoliated in 1993.

Disease Conditions by Region

Diseases: Native

Annosus root disease, *Heterobasidion annosum*

Region 1: Idaho, Montana

Host(s): Douglas-fir, grand fir, ponderosa pine, subalpine fir, western hemlock

Annosus root disease is common in ponderosa pine stands on the Flathead Indian Reservation and in other western Montana locations. It is widespread on Douglas-fir and true firs on the Clearwater, Nez Perce, and the Idaho Panhandle National Forests in Idaho.

Region 2: Colorado, Nebraska

Host(s): Ponderosa pine, white fir

In 1994, the disease was identified in the Cade Mountain Timber Sale Area on the Pagosa Ranger District, San Juan National Forest.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine, true firs

Root diseases and their associated pests are responsible for about one-third of the conifer mortality region-wide. *Heterobasidium annosum* accounts for about 20 percent of this mortality. In 1994, *H. annosum* was found infecting up to 1 percent of the standing trees in stands with heavy mortality on the North Kaibab Ranger District of the Kaibab National Forest.

Region 4: Idaho, Nevada, Utah, Wyoming, California

Host(s): Bitterbrush, chokecherry, Douglas-fir, Engelmann spruce, Jeffrey pine, lodgepole pine, true firs

Infection causes varying amounts of root and butt rot in mature individuals of many tree species, and may result in predisposition to windthrow and/or beetle attack. In grand fir and subalpine fir, it is commonly found as a butt rot. Infection-induced mortality occurs occasionally in young ponderosa pine and seldom in other hosts.

Region 5: California

Host(s): Conifers, some hardwoods

Annosus root disease and bark beetles caused high levels of tree mortality in many partially cut mixed-conifer and eastside-pine stands in northeastern California. Losses were high in areas stressed by a 7-year drought. Approximately 1.7 million acres of pine and 1.0 million acres of true-fir

type are infested with this root and butt disease. It is also damaging several giant sequoias in Sequoia National Park.

Region 6: Oregon, Washington

Host(s): Ponderosa pine, true firs, western hemlock

Annosus root disease causes losses in many partially cut stands of white and grand fir in southern and eastern Oregon and eastern Washington. Mortality was high where annosus root disease and fir engraver beetles operate as a complex. The new regional vegetation inventory, which now requires examination of cut stumps, has led to increased reporting and awareness of annosus root disease on many forests. In eastern portions of the region where many stands were cut 10 to 20 years ago, trees surrounding cut stumps are dying. Disease severity is expected to increase with time. Annosus root disease was observed with increasing frequency in stands that are predominantly ponderosa pine on drier sites in eastern Washington and Oregon. Reports of the disease in mountain hemlock and Pacific silver fir in high-elevation stands in the Cascade Range are also increasing. Annosus root disease in low-elevation western hemlock stands primarily causes butt rot; impacts are considered low unless stands are managed at rotations greater than 120 years.

Region 8: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia

Host(s): Southern pines (loblolly, longleaf, shortleaf, and slash pines), eastern white pine

Annosus root disease continued to cause significant losses of its pine host in region 8. Mortality and growth losses range from 2 to 25% of growing stock volume of managed high-risk stands across the south. The disease is most often associated with thinned pine plantations on sandy, well-drained sites but can be found on a variety of sites, soils, and forest conditions. Bark beetle infestations frequently occur within infected stands.

Armillaria root disease, *Armillaria* spp.

Region 1: Idaho, Montana

Host(s): Douglas-fir, other conifers

Armillaria root disease (*A. ostoyae*) is widely distributed in northern Idaho and western Montana. The apparent increase of this root disease in parts of Region 1 is attributed, in part, to the increase in Douglas-fir and true firs resulting from fire control and selective harvesting of high-value pine and western larch early in the 20th century. It is also a major cause of mortality in young ponderosa pine plantations (15 to 25 years old).

Region 2: Colorado, South Dakota, Wyoming

Host(s): Englemann spruce, lodgepole pine, ponderosa pine, subalpine fir, white fir

Fifty-seven collections of *Armillaria* spp. from widely scattered infected trees, including nine host species in seven national forests throughout Col-

orado, South Dakota, and Wyoming have been identified as the biological species *Armillaria ostoyae*. Work is continuing on the identification of additional collections made in 1994. An extensive survey of the ponderosa pine vegetation type on the Dolores and Mancos Ranger Districts, San Juan National Forest, showed that armillaria root disease is uncommon and of minor management importance. In contrast, the disease is a major problem in spruce/fir leave strips in the ski areas near Aspen, Colorado. In 1994, detailed assessments of the disease carried out in (1) spruce/fir stands near Dunton, Colorado; (2) white spruce stands in the Black Hills National Forest; and (3) in the spruce/fir leave strips at Aspen Mountain Ski Resort, White River National Forest and Crested Butte Ski Resort, Gunnison National Forest.

Region 3: Arizona, New Mexico

Host(s): Aspen, Douglas-fir, ponderosa pine, spruce, true firs

Root diseases and their associated pests are responsible for about one-third of the conifer mortality region-wide. *Armillaria* spp. account for about 80 percent of this mortality. A greater percentage of the mixed conifer and spruce-fir forests are infected compared to ponderosa pine type. Region 3 is working to fill gaps of knowledge on the occurrence and effects of armillaria and other root diseases in Southwest forests. In 1994, armillaria was found infecting up to approximately 30% of the standing trees in stands with heavy mortality on the North Kaibab Ranger District of the Kaibab National Forest.

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Douglas-fir, grand fir, pines, spruce, subalpine fir

Evidence of armillaria root disease can be found throughout the Region. In southern Idaho, northern Utah, Nevada, and Wyoming, it functioned primarily as a weak pathogen or saprophyte causing little direct mortality. In southern Utah, it may act as a primary pathogen, killing mature and immature ponderosa pine and mature fir and spruce.

Region 5: California

Hosts: Conifers, some hardwoods

Armillaria root disease commonly killed a wide range of conifers and hardwoods planted in parks and gardens. The fungus is especially damaging in areas where trees were over-watered. In natural stands, *Armillaria spp.* killed pockets of native oaks, Douglas-fir, ponderosa pine, sugar pine, and other forest trees scattered throughout California.

Region 6: Oregon, Washington

Host(s): Conifers

The most serious losses from this pathogen (*A. Ostoyae*) occurred east of the Cascade Range in mixed conifer stands. In some stands in eastern Oregon where soils are compacted or displaced, mortality was high and is expected to continue. True firs and Douglas-fir sustain the most losses; however, in localized areas, ponderosa pine mortality was significant. At mid- to high-elevation stands in the Cascades of southwestern Oregon,

armillaria root disease causes mortality of several conifer species. Mortality on lower slopes west of the Cascades and in the Coast Range was usually confined to younger, stressed trees. Assessing species resistance on a site-by-site basis and discriminating for the more resistant species during stand management activities is considered the most effective means of controlling spread and mortality.

Region 9/Northeastern Area: Maine, Michigan

Host(s): Red pine

In Michigan, conifer conversion of higher quality hardwood sites have low level mortality.

Black stain root diseases, *Ceratocystis wageneri* *Leptographium wageneri* *Ophiostoma wageneri*

Region 1: Idaho, Montana

Host(s): Douglas-fir, lodgepole pine, ponderosa pine

Black stain root disease (*C. wageneri*) is less common than other root pathogens and its importance in region 1 is largely unknown.

Region 2: Colorado

Host(s): Pinyon, ponderosa pine

Leptographium wageneri continues to occur on ponderosa pine in interior portions of Colorado and on pinyon pine in the southwestern corner of the state. In 1994, a detailed assessment of the spread charateristics of black stain root disease was initiated at McPhee Reservoir on the Dolores Ranger District, San Juan National Forest.

Region 3: New Mexico

Host(s): Douglas-fir, pinyon

Both *Leptographium wageneri* var. *wagneri*, which infects pinyon, and *L. wagneri* var. *pseudotsugae*, which infects Douglas-fir, are rare in the Southwestern Region. The former is confined to two isolated areas in northern New Mexico and the latter has been observed only in sites in south-central New Mexico.

Region 4: Idaho, Nevada, Utah

Host(s): Pinyon

Ophiostoma wageneri causes mortalitry of pinyon on the Bureau of Land Management Burley District in Idaho, on the Humbolt and Toiyabe National Forests in Nevada, and on the Dixie and Manti-LaSal National Forests in Utah.

Diseases: Native

Region 5: Northern California

Host(s): Douglas-fir, Jeffrey pine, pinyon pine, ponderosa pine.

In northwestern California, black stain root disease (*L. wageneri*) is damaging Douglas-fir plantations and mature trees, extending from the Oregon border to as far south as Santa Cruz County. Thousands of acres of ponderosa pine in northeast California and pinyon pine in Southern California have infected trees. The disease is associated with wet sites, over-stocking, and site disturbance.

Region 6: Oregon, Washington

Host(s): Douglas-fir, ponderosa pine

In southwestern Oregon, black stain root disease (*O. wageneri*) was the most commonly encountered disease in Douglas-fir plantations. High risk areas are considered to be those where disturbances such as road building or soil compaction have occurred or where road maintenance equipment injured roadside Douglas-firs. Infected larger individuals were found scattered in previously entered forest stands. Black stain root disease continues to be observed on ponderosa pine east of the Cascades.

Brown root disease, *Phellinus noxious*

Region 5: Northern Marianas Islands

Host(s): Flame trees (*Delonix regia*), other hardwoods

On Saipan and Rota, the fungus is killing prominent trees in naturalized stands and ornamental plantings. Trees of all ages and sizes are dying in scattered centers throughout these islands.

Dwarf mistletoes, *Arceuthobium* spp.

Region 1: Idaho, Montana

Host(s): Douglas-fir, lodgepole pine, ponderosa pine, western larch

Lodgepole pine dwarf mistletoe infected approximately 2 million acres (28 percent) of the lodgepole type in region 1 and caused an estimated 18 million cubic feet of growth reduction. Dwarf mistletoe is locally heavy in ponderosa pine stands around Lake Coeur d'Alene and along the Spokane River drainage in northern Idaho. Douglas-fir dwarf mistletoe infected about 0.6 million acres (13 percent) of Douglas-fir, reducing growth by approximately 13 million cubic feet. Western larch dwarf mistletoe occurred on about 0.8 million acres (38 percent) of western larch stands and reduced growth by over 15 million cubic feet.

Region 2: Colorado, Wyoming

Host(s): Douglas-fir, lodgepole pine, limber pine, pinyon pine, ponderosa pine

Dwarf mistletoes cause the greatest disease losses in Region 2. Losses equal at least 10 million cubic feet annually. In Colorado, 50 percent of the lodgepole pine type is infected with *A. americanum*. Forest Health Management funded presuppression surveys on 16,741 acres on five national forests and silviculture control on 703 acres on six national forests. Sanitation thinning was also completed on 11 campgrounds on the Gunnison and San Isabel National Forests. Dwarf mistletoe is widespread on the Bighorn and Shoshone National Forests.

Limber pine dwarf mistletoe (*A. cyanocarpum*) continued as a minor problem in Colorado.

Arceuthobium douglasii occurs on Douglas-fir, mostly in the southern two-thirds of the state. Moderate to high infestation levels were detected in forest stands near North Cochetopa Pass. In 1994, Forest Health Management provided funds for silvicultural control on 10 acres on the Salida Ranger District, San Isabel National Forest.

Losses amount to 885,000 cubic feet annually on ponderosa pine by *A. vaginatum* ssp. *cryptopodum*. Suppression projects emphasized tree removal and pruning of infected trees in developed recreation sites. Sanitation-thinning has been completed over the past few years on 1,000 acres on the South Platte Ranger District, Pike National Forest; on 350 acres on the Salida Ranger District, San Isabel National Forest; and in 1994, on 215 acres on the Southern Ute Reservation in southern Colorado. An extensive survey of the ponderosa pine vegetation type on the Dolores and Mancos Ranger District, San Juan National Forest, showed that dwarf mistletoe is present in 31 percent of the 79,628 acres that were rated for infestation. A detailed assessment of the effects of uneven-aged management on ponderosa pine dwarf mistletoe was initiated at the Craig Point Sale Area of the Uncompahgre Plateau on the Norwood Ranger District, Uncompahgre Nationl Forest.

Pinyon pine dwarf mistletoe (*A. divaricatum*) continued as a minor problem in western Colorado, but concern is increasing in western Colorado as more people move into the area.

Region 3: Arizona, New Mexico

Host(s): Douglas-fir, pines, spruce, true firs

Dwarf mistletoes are the most significant disease-causing agents in the Southwestern Region. Over one million acres of national forest commercial timberlands in each state have some level of dwarf mistletoe infection. Several hundred thousand additional infected acres occur in noncommercial and reserved areas, woodlands, and other public and private forest lands. There is some evidence that the incidence of dwarf mistletoe on ponderosa pine has increased in recent decades. This increase is likely a result of fire suppression (fire being the primary natural control agent) and selective cutting. Other dwarf mistletoe species have probably also increased for these reasons.

Diseases: Native

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Douglas-fir, Jeffrey pine, lodgepole pine, ponderosa pine, true firs, western larch, whitebark pine

Suppression projects continue to remove infected overstory trees; however, this forest disease remains the most widespread and frequently observed disease within the Intermountain Region. Regional incidence by major host species is as follows: lodgepole pine = 45 percent infected, ponderosa pine = 25 percent infected, and Douglas-fir = 33 percent infected.

Region 5: California

Host(s): Douglas-fir, Pines, true fir

Mistletoes are infesting conifers on about 2.2 million acres of national forest lands with approximately 25.5 percent of the acres in the region infected. These infections are slowing tree growth, contributing to tree mortality, and altering forest successional patterns. Dwarf mistletoes' distribution and impacts change slowly from year to year. Dwarf mistletoe was associated with branch flagging in red and white fir throughout the central and southern Sierra Nevada. Drought stress, bark beetles, and cytospora canker were involved in this pest complex.

Region 6: Oregon and Washington

Host(s): Conifers

Dwarf mistletoes are present on approximately 9.5 million acres of forested lands in the Pacific Northwest Region. Their status changes little from year to year. However, long-term impacts, including reduced growth, mortality, deformity, and topkill, are significant, particularly in unmanaged stands. All conifer species are affected to some degree. Douglas-fir dwarf mistletoe is abundant east of the Cascades and in southwestern Oregon. Western larch dwarf mistletoe causes significant effects in northeastern Oregon and central to eastern Washington.

Dwarf mistletoe incidence data from the timber inventory (1976 to 1987) in national forests within range of the northern spotted owl indicate that 26.5 percent of stands of western hemlock have dwarf mistletoe on western hemlock and 20.7 percent of stands with mountain hemlock have dwarf mistletoe on mountain hemlock.

Region 9/Northeastern Area: Maine, New Hampshire, New York

Host(s): Spruce

Eastern dwarf mistletoe (*A. pusillum*) damage continues to occur in coastal Maine and the mountains of New Hampshire and New York.

Fusiform rust,
Cronartium quercuum
f. sp. *fusiforme*

Region 8: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Texas, Virginia

Hosts: Southern pines

Fusiform rust is the most damaging disease of loblolly and slash pines in the South. Other pine species may also be infected, but little mortality or other damage occurs. Regional analysis of fusiform rust incidence was done in 1993 using the most recent Forest Inventory and Analysis (FIA) survey data. FIA data are updated every 6 to 7 years in individual states. Because only a few state summaries were updated in 1994, loss estimates are unchanged from last year's report. An estimated 13.7 million acres of loblolly and slash pines have infection levels greater than 10 percent; this represents 30 percent of the total host acres. Georgia has the worst disease situation with 4.6 million acres with 10 percent or more infection; this represents 49 percent of the host type.

Laminated root rot,
Phellinus weirii

Region 1: Idaho, Montana

Host(s): Douglas-fir, grand fir

Laminated root disease is very severe on parts of the Lolo and Kootenai National Forests in Montana, as well as the Idaho Panhandle and Nez Perce National Forests in Idaho. Damage from laminated root disease has increased in recent years. This is attributed to the loss of root disease–tolerant western white pine to blister rust and other factors that have increased the abundance of Douglas-fir and grand fir during the present century.

Region 6: Oregon, Washington

Host(s): Conifers

Laminated root rot was the most serious forest tree disease west of the Cascade Mountains in Washington and Oregon. Overall, an estimated 8 percent of the area in susceptible species is affected in this portion of the region. Locally, the area affected may be as much as 15 to 20 percent of the area is affected. East of the Cascades, laminated root rot affects mixed conifer stands north of the Crooked River in central and northeastern Oregon and throughout eastern Washington. Effects of the disease include significant changes in species composition, size, and structure. Regeneration of susceptible species in root disease centers may not grow beyond sapling and pole-size. Hardwood trees and shrubs, which are immune to the fungus, often increase their site occupancy.

Diseases: Native

Oak wilt,
Ceratocystis fagacearum

Region 2: Kansas, Nebraska

Host(s): Oak species

The disease continues to slowly spread in the eastern third of Kansas.

Region 8: Arkansas, Kentucky, North Carolina, South Carolina, Tennessee, Texas, Virginia

Host(s): Oaks, mainly red oak group; live oaks in Texas

Oak wilt continues to be epidemic in central Texas. New detections increased the number of affected counties to 55. One new site was just outside of Houston. A cooperative oak wilt suppression project continues in central Texas. In other states, little new or serious disease activity was reported.

Region 9/Northeastern Area: Iowa, Minnesota, West Virginia, Wisconsin

Host(s): Black oak, red oak, white oak

Iowa reported mortality from oak wilt on approximately 8,800 acres. In Minnesota, oak wilt is a problem primarily in the seven counties around Minneapolis and St. Paul. West Virginia reported red oak mortality in 5 counties (in some of the counties, in urban settings). Wisconsin reported oak wilt in 50 counties, with increased reporting in many urban areas due to a public awareness campaign.

Diseases: Nonnative

Beech bark disease,
Nectria coccinea
var. *faginata*

Region 8: North Carolina, Tennessee, Virginia

Host(s): American beech

Mortality caused by this disease was found in the Great Smoky Mountains National Park, 300 miles southwest of the previously known occurrence of this disease. The affected area is approximately 100 acres within a three county area: Swain and Haywood Counties, North Carolina, and Sevier County, Tennessee.

Region 9/Northeastern Area: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia

Host(s): American beech

In Vermont, approximately 780 acres of damage was reported. Levels of scale and *Nectria* were stable in monitoring plots, although tree condition has declined somewhat. In West Virginia, mortality scattered over 606,000 acres has occurred in Pendleton, Pocahontas, Randolph, and Tucker Counties.

Dutch elm disease,
Ceratocystis ulmi

Region 1: Idaho, Montana, North Dakota

Host(s): American elm

Dutch elm disease continued to spread in urban areas in North Dakota and Montana. Montana's highest losses are occurring in Billings and Great Falls. In North Dakota, heavy losses have occurred at the Knife River Indian Villages National Historic Site. In northern Idaho, it has been reported in Moscow where several infected trees were removed in 1994.

Region 2: Colorado, Kansas

Host(s): Elm species

Incidence was up slightly in 1993. This is the result of freeze damage of October 1991. There was a large increase in trunk attacks due to the 1991 freeze, increasing declining trees in the Colorado Springs area. Dutch elm disease was confirmed from two Regal elms collected from a Colorado Springs nursery. Dutch elm disease is still a serious problem in many Kansas urban areas. Reports of the disease were the same as in 1992.

Diseases: Nonnative

Region 8: Regionwide

Host(s): Elm species

Dutch elm disease (*Ophiostoma ulmi* = *Ceratosystis ulmi*) was detected along the Natchez Trace Parkway (USDI National Park Service) in seven additional Mississippi counties in 1994.

Region 9/Northeastern Area: Areawide

Host(s): American elm

In Maine, symptoms were quite conspicuous during the summer of 1994. A more agressive strain of *Ophiostoma ulmi*, *O. novo-ulmi* = *Ceratosystis ulmi* is apparently completing its sweep across the state, killing elms that survived the original infective "front" of the 1950's. Dutch elm disease continues to cause mortality of American elm through the northeastern United States.

European larch canker, *Lachnellula willkommii*

Region 9/Northeastern Area: Maine

Host(s): Eastern larch

Maine reports that the disease apparently did not spread from known areas of infestation during 1994. It remains confined to parts of Washington, Hancock, Waldo, Lincoln, and Knox Counties.

White pine blister rust, *Cronartium ribicola*

Region 1: Idaho, Montana

Host(s): Western white pine, whitebark pine

White pine blister rust caused extensive tree mortality throughout the range of western white pine and prevented management of wild-type western white pine on high-hazard sites. Restoration of stands damaged by blister rust and other factors is progressing by planting them with rust-tolerant white pine. Blister rust occurs throughout the range of whitebark pine, causing severe mortality in many stands in northern Idaho and western Montana.

Region 2: Colorado, South Dakota

Host(s): Limber pine

Branch and tree mortality continued at several Wyoming locations in the Bighorn and Shoshone National Forests. The disease is present at a remote stand in the Black Hills of South Dakota.

Region 3: New Mexico

Host(s): Southwestern white pine

White pine blister rust occurs throughout most of the range of southwestern white pine (*Pinus strobiformis*) in the Sacramento Mountains and adjoining White Mountains of southern New Mexico. Roughly half a million acres are affected. In 1994, low levels of the disease were confirmed in the Capitan Mountains, an isolated range approximately 30 miles from the main outbreak area.

Region 4: Idaho

Host(s): Whitebark pine

White pine blister rust occurs infrequently in southern Idaho because of the widely scattered host. High levels of infection in localized areas result in branch, top, and entire tree mortality of hosts.

Region 5: California

Host(s): Sugar pine, western white pine, whitebark pine

Blister rust infects five-needled pines throughout the Sierra Nevada and Coast Range and is killing trees in many areas. In general, levels of blister rust were low on *Ribes* spp. throughout northern California. Due to dry conditions during the summer, levels did not build up. In 1994, forty new sugar pine selections were identified with major gene resistance.

Region 6: Oregon and Washington

Host(s): Sugar pine, western white pine, whitebark pine

Cronartium ribicola was introduced to the West Coast in 1910. Its effects include topkill, branch flagging, and tree mortality. Although much of the mortality associated with this disease occurred earlier in the century, its impacts are still great in wild populations of five-needled pines throughout their range. Locally, this disease, in combination with mountain pine beetle, threatens the health of the species. Of particular concern are the effects of blister rust in whitebark pine at high elevations in the Cascades. An attempt was made to identify areas symptomatic of blister rust from the air in 1994. Although blister rust is known to occur extensively throughout the range of susceptible host type, observers only mapped 3,000 acres in Washington (1,800 acres in whitebark pine and 1,200 acres in western white pine). The bulk of the reported acreaged fell within the Okanogan, Wenatchee, and Colville National Forests and best represented symptoms the observers felt were distinquisable from the more easily observed affects of mountain pine beetle.

Region 9/Northeastern Area: Maine, New Hampshire, Vermont

Host(s): Eastern white pine

This disease occurs statewide in Maine. Attempts have been made to control it by eradicating its hosts (*Ribes* spp.) in southern Maine. No significant activity was reported from New Hampshire or Vermont.

Diseases: Origin unknown

Butternut canker, *Sirococcus clavigignenti-juglandacearam*

Region 8: Alabama, Arkansas, Mississippi, Georgia, North Carolina, Tennessee, Virginia

Host(s): Butternut

Butternut has been present in Region 8 for at least 40 years, killing an estimated 77 percent of butternut trees. The USDA Forest Service has placed a moratorium on the harvesting of healthy butternuts. Trees exhibiting resistance were found in North Carolina, Kentucky, and Arkansas. These trees are being propagated by grafting and nut collection for host resistance studies. Butternut canker is projected to spread and kill most of the species, including regenerating trees.

Region 9/Northeastern Area: Connecticut, Iowa, Illinois, Indiana, Maine, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New York, Pennsylvania, Ohio, Vermont, West Virginia, Wisconsin

Host(s): Butternut

In Vermont, butternut canker is present throughout the state. Butternut was found to be the least healthy tree species in the 1994 statewide roadside tree survey. In New Hampshire, 7 of 10 counties had confirmed butternut canker. Butternut canker is widespread in Maine, having been found in 12 of 16 counties. New York continues to survey for both healthy and declining butternut trees. This year was the first time butternut canker has been located in Bronx, County. Ohio reported mortality of 5 butternut trees in Portage County. Pennsylvania reported 41 acres of butternut canker damage in Adams and Northampton Counties. In Wisconsin, butternut canker has been found and confirmed in 46 counties.

Dogwood anthracnose, *Discula destructiva*

Region 8: Alabama, Georgia, Kentucky, North Carolina, South Carolina, Tennessee, Virginia

Hosts: Flowering dogwood

Dogwood anthracnose was first noted in the South in 1987 with the report of 30,000 acres affected in the Cohutta Wilderness in northern Georgia. Surveys and impact plots across the seven affected southern states have now identified 228 counties affected by this disease. Dogwood anthracnose is primarily found in the mountains, foothills, and upper Piedmont. Damage is most severe in the forest environment at higher elevations and in cool moist areas in the lower elevations.

Region 9/Northeastern Area: Connecticut, District of Columbia, Indiana, Maine, Maryland, Massachusetts, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia

Host(s): Flowering dogwood

In New York, dogwood anthracnose was confirmed on samples collected from flowering dogwood in Suffolk, Rensselaer, and Washington Counties. Dogwood anthracnose caused mortality in Vinton and Stark Counties, Ohio. In Vermont, dogwood anthracnose was confirmed in three remaining sites in Windham County where flowering dogwood is known to occur naturally. Dieback on sample trees ranged from 30 to 100 percent. In Missouri, 4 counties confirmed to have dogwood anthracnose. The Indiana Division of Entomology and Plant Pathology confirmed the introduction of dogwood anthracnose during 1994 into 26 counties. Most of the introductions were found in garden centers, and stop-sale orders were issued immediately.

Pitch canker, *Fusarium subglutinans*

Region 5: California

Host(s): Bishop pine, Monterey pine, Monterey pine X knobcone pine, Douglas-fir

Pitch canker has been found in all three of the native Monterey stands in central California. Infections in a native stand of Bishop pine and an ornamental planting of Douglas-fir are raising new concerns regarding the potential ecological impact of this insect and disease complex. Resistance has been identified in Monterey pine trees near Santa Cruz. Hundreds of planted Monterey pines have died along scenic highways in Monterey and Santa Cruz counties.

Port-Orford-cedar root disease, *Phytophthora lateralis*

Region 5: California

Host(s): Port-Orford-cedar, Pacific yew

The range of Port-Orford-cedar root disease did not expand significantly in the past year. It remains limited to the Smith River drainage in extreme northwestern California. Roads are being closed in the wet season, limiting access to Port-Orford-cedar and thereby lessening the risk of disease spread.

Region 6: Oregon

Host(s): Port-Orford-cedar

Port-Orford-cedar root disease causes mortality of its host in southwestern Oregon. Where it has been introduced, the disease causes extensive mortality on sites favorable for infection and spread of its water-borne spores, especially along creeks, in low-lying areas, and below roads where water is channelled. Evidence of the disease was reported over a total of

21,000 acres. Within these areas, mortality was distributed as scattered pockets or individual trees.

Other Conditions by Region

Declines and Complexes

Ash decline

Region 9/Northeastern Area: Areawide

Host(s): Brown (black) ash, green ash, white ash

A serious decline (approximately 120,000 acres) in brown ash in Maine is still extremely apparent, but conditions stabilized somewhat in 1994. In Ohio, dieback and mortality of white and green ash continued to occur in seven counties. Pennsylvania reported ash decline on white ash in seven counties. In West Virginia, 8 new finds of ash yellows have been confirmed. Over 1,500 acres of mortality occurred on black ash on the Ottawa National Forest in Michigan.

Large aspen tortrix, *Choristoneura conflictana* Marssonina leaf blight, *Marssonina populi* Western tent caterpillar, *Malacosoma californicum*

Region 3: Arizona, New Mexico

Host(s): Aspen

Aspen defoliation caused by this complex of insects, disease, and abiotic factors decreased from 17,220 acres in 1993 to 9,030 acres in 1994. Defoliation on federal lands in Arizona included 355 acres on the Apache-Sitgreaves National Forest, 535 acres on the Coconino National Forest, 120 acres on the Coronado National Forest, 1,350 acres on the Kaibab National Forest, 290 acres on the Tonto National Forest, and 390 acres on the Fort Apache Indian Reservation. An additional 50 acres of defoliation also occurred on state and private land in Arizona. In New Mexico, aspen defoliation caused by this complex totaled 5,940 acres. Defoliation occurred on 400 acres on the Carson National Forest, 240 acres on the Cibola National Forest, 400 acres on the Gila National Forest, 800 acres on the Lincoln National Forest, 3,460 acres on the Santa Fe National Forest, 280 acres on the Mescalero Apache Indian Reservation, 160 acres on the Santa Clara Pueblo Indian Reservation, 160 acres on the Taos Pueblo Indian Reservation, and 40 acres of adjacent non-industrial private lands.

Large aspen tortrix,
Choristeneura conflictana
Omnivorous leafroller,
Archips purpurana
Oblique banded leafroller,
Choristeneura rosaceana
Dusky leafroller,
Orthotania undulana
Spotted aspen leafroller,
Pseudosciaphilia duplex
Agonoterix argillacea
Epinotia criddleana

Region 9/Northeastern Area: Minnesota

Host(s): Aspen

Minnesota experienced over 600,000 acres of defoliation by this complex of insects.

Maple decline

Region 9/Northeastern Area: Maine, Michigan

Host(s): Sugar maple

Data from the North American Maple Project plots indicate that sugar maples in Maine are healthy. In Michigan, sugar maples continued to display decline symptoms in areas scattered throughout the Upper Peninsula. The decline is a response to the severe droughts of 1987–1989, and no new areas of decline were detected in the state.

Oak decline

Region 8: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia

Hosts: Oaks and common associates such as hickories

Oak decline is a syndrome resulting in dieback and mortality of dominant and codominant mature oaks. Causal factors are stressors such as drought, frost, defoliation by insects, secondary agents such as armillaria root disease and two-lined chestnut borer. Host, age, and site conditions also play a role. Analysis of forest inventory data in 12 southern states indicate an estimated 3.9 million acres of upland hardwood forest are affected by oak decline—about 9.9 percent of the vulnerable host type. Average annual mortality volume of oaks on affected sites was 45 percent higher than on unaffected areas. Some of the oak decline reported here is located in areas heavily defoliated by the gypsy moth (see gypsy moth entry).

Spruce-fir decline

Region 9/Northeastern Area: Maine, New Hampshire, New York, Vermont, West Virginia

Host(s): Balsam fir, red spruce

Dieback and mortality in New York, West Virginia, and northern New England continues at high elevations.

Alaska yellow-cedar decline

Region 10: Alaska

Host(s): Alaska yellow-cedar

Alaska yellow-cedar decline remains the primary forest health concern in southeast Alaska. Alaska yellow-cedar (*Chamaecyaparis nootkatensis*) has been dying on over 579,600 acres in southeast Alaska. The primary cause appears to be a naturally occurring abiotic factor. Decline areas have not substantially increased or decreased in the last 100 years; however, effects on those acreages are intensifying and decline of this valuable tree species is expected to continue. Impacts include reduced subsistence use, diminished timber value, and altered successional patterns. Coupled with harvesting and inadequate natural regeneration, decline is contributing to a reduction of yellow-cedar populations. Recent management efforts have been directed towards artificial regeneration of yellow-cedar.

Seed Orchard Insects and Diseases

Coneworms, *Dioryctria* spp.

Region 5: California

Host(s): Afghanistan pine, Douglas-fir, ponderosa pine

Coneworms (*Dioryctria* spp.) continue to cause damage at the Chico Genetics Resource Center.

Region 8: Regionwide

Host(s): Southern pines

Coneworms continued to cause damage in seed orchards across the South. The webbing coneworm, *Dioryctria disclusa*, occurred in high numbers in loblolly pine orchards in North and South Carolina. Late season damage by the southern pine coneworm, *D. amatella* and *D. merkeli* was recorded in orchards in Texas and Louisania. Damage by the blister coneworm, *D. clarioralis*, was minimal across the South. Coneworm damage caused losses of 5 to 25 percent of the cone crops in several orchards monitored in Louisiana and Mississippi. Longleaf pine seed continues to suffer heavy damage from coneworms in combination with other insects.

Filbertworm, *Cydia latiferreana*
Acorn weevils, *Curculio* spp., and *Conotrachelus* spp.
Pip gall wasp, *Callirhytis operator*
Carpenterworm, *Prionoxystus robiniae*

Region 8: Tennessee

Host(s): Northern red oak

A complex of insect pests continue to cause serious losses in northern red oak seed production efforts. Two generations of filbertworm caused unexpectedly heavy damage to the acorn crop. This is the first report of filbertworm having two flights. High populations of acorn weevils further reduced the acorn harvest. Pip gall damage increased over 1993 levels and carpenterworm was discovered in more than half of the orchard trees. This insect is capable of causing significant long term-damage to tree vigor by introducing fungal pathogens such as heart rot.

Seed bugs,
Leaffooted pine seed bug
Leptoglossus corculus
Shieldbacked pine seed bug
Tetyra bipunctata

Region 8: Regionwide

Host(s): Southern pines

Seed bug populations in seed orchards continued to cause damage across the South. Damage varies by geographic location, ranging from 5 to 10 percent in monitored orchards in the Gulf Coast, to 25 percent in one orchard in South Carolina. Seed bug feeding is a significant cause of conelet abortion in longleaf pine, severely hampering efforts to regenerate this important component of coastal plain ecosystems.

Western conifer seed bug,
Leptoglossus occidentalis
Lodgepole pine cone moth,
Eucosma rescissoriana
Fir coneworm,
Dioryctria abietivorella

Region 1: Idaho, Montana

Host(s): Conifers

Cone and seed insects are becoming of increased significance in Region 1 because of the high value of the blister-rust-resistant western white pine seed being produced and because several orchards of other tree species are reaching cone-bearing age. The primary insect pests of concern are the western conifer seed bug, the lodgepole pine cone moth, and the fir coneworm. The western conifer seed bug was abundant throughout northern Idaho,in 1994. It was potentially damaging enough at the Coeur d'Alene white pine seed orchard to require insecticidal spraying. Also, spraying was required at the Moscow, Idaho, seed orchard to control seed bugs, cone worms and cone moths.

White pine cone beetle,
Conophthorus coniperda

Region 8: North Carolina, Tennessee

Host(s): Eastern white pine

White pine cone beetle populations increased in three of the four Tennessee orchards in 1994. Damage was severe on untreated orchards. At the USDA Forest Service Beech Creek Seed Orchard (North Carolina), beetle populations (and damage) were below the 5-year average, but increased over 1993.

Nursery Insects and Diseases

Animal damage

Region 6: Oregon

Host(s): All species

At one nursery, extensive house construction on adjacent open land appears to be driving rodent populations into the nursery beds. Gophers, rockchucks, mice, and rabbits have been observed.

Black vine weevil, *Otiorhynchus sulcatus*

Region 5: Northern California

Host(s): Douglas-fir, Red fir

Damage continued in some blocks at Humboldt Nursery.

Seedling diseases, *Botrytis cinerea* *Cylindrocarpon* spp. *Fusarium* spp. *Phoma eupyrena* *Pythium* spp. *Sirococcus strobilinus* *Sphaeropsis sapinea*

Region 1: Idaho, Montana

Host(s): Conifers

The most common and damaging diseases of conifer seedlings in nurseries in Region 1 are root diseases caused by *Fusarium* spp. These fungi cause damping-off and root diseases on many different conifer hosts in bareroot and container nurseries. The most common soil borne pathogen species in bareroot nurseries is *F. oxysporum*, although several other species are commonly isolated from infested soil and diseased seedlings. The major pathogen in container nurseries is *F. proliferatum*, although *F. oxysporum* and several other fusaria may occur at high levels in some nurseries. Although all conifer species are susceptible, most damage occurs on Douglas-fir, western larch, western white pine, and Engelmann spruce. *Fusarium acuminatum* occurred at very high levels on whitebark pine seed, especially on selected lots from the Gallatin National Forest, Montana. This fungus may adversely affect seed germination and contribute to reduced seedling establishment. *Botrytis cinerea* was more prevalent in 1994 than in recent years on nursery seedlings at several locations. It also caused damage to large plantation trees at several sites in northern Idaho. This facultative parasite colonizes necrotic tissues killed by other agents. It

caused unusually high levels of damage to container-grown western redcedar seedlings at the Forest Service nursery in Coeur d'Alene. Stock was especially damaged after being in cold storage during the winter. *Cylindrocarpon* spp. (especially *C. destructans*) continued to cause unacceptable losses to western white pine and whitebark pine seedlings. Damage to other conifer species also occurs, but root decay of five-needled pines is most serious. Tip dieback caused by *Sirococcus strobilinus*, *Sphaeropsis sapinea*, and *Phoma eupyrena* occurred at several nurseries on bareroot pine seedlings. Ponderosa pine and lodgepole pine were the most commonly affected species. Pythium root disease (mostly from *P. ultimum*) occurs at some level at most bareroot nurseries but can also be found in container seedlings. Damage is usually minor and can be mitigated by improving water drainage in soil and container media.

Fusarium root disease
***Fusarium* spp.**

Region 4: Idaho, Utah

Host(s): Douglas-fir, ponderosa pine, true firs

Fusarium root disease (*Fusarium oxysporum*) causes small amounts of mortality primarily of 1+0 conifer seedlings at the Lucky Peak Nursery, Boise National Forest, Idaho and the Lone Peak Nursery in Utah.

Region 5: California

Host(s): Douglas-fir, sugar pine, true firs and others

Damping-off, chlorosis, stunting, and hypocotyl rot caused by *Fusarium* spp. were scattered throughout first-year-seedling red fir, white fir, sugar pine, and other species in many California forest nurseries. Losses due to *Fusarium* were reduced by sowing in February rather than April at the Placerville Nursery in northern California. Early-sown sugar pine and red fir seedlings were exceptionally large and vigorous.

Region 6: Oregon, Washington

Host(s): Conifers

Three nurseries experienced an average of approximately 1 percent mortality to damping-off caused by *Fusarium* spp. and *Pythium* spp. Fumigation, deep watering, and delayed fertilization helped control damping-off.

Many species experienced scattered losses caused by fusarium root rot and hypocotyl rot (*Fusarium* spp.) at the three nurseries.

Gray mold,
Botrytis cinerea

Region 6: Oregon, Washington

Host(s): Conifers

Damage by gray mold has been kept low (less than 1 percent of crop damaged) through applications of fungicide, regulation of seedbed densities, and prompt removal of dead material, including pruned tops, from nursery beds.

Phoma Tip Blight,
***Phoma* sp.**

Region 6: Oregon

Host(s): Ponderosa pine

For the first time in 4 to 5 years, phoma tip blight caused damage on 2+0 ponderosa pine at one nursery. Fertilization before May 10th and a moist spring resulted in succulent growth that was susceptible to *Phoma* infection.

Phytophthora root rot,
***Phytophthora* spp.**

Region 4: Idaho, Utah

Host(s): Douglas-fir, spruce

Phytophthora spp. and *Pythium* spp. fungi occur infrequently on seedlings and in soil at the Lucky Peak Nursery, Boise National Forest, Idaho, and the Lone Peak Nursery in Utah. Infection results in patch mortality and culling of 2+0 seedlings.

Region 6: Oregon, Washington

Host(s): Conifers

Seedbed seedling damage was confined primarily to nursery beds with poor drainage or compaction layers in the rooting zone.

Region 8: North Carolina

Host(s): Fraser Fir

Phytophthora root rot caused a loss of 1,100,000 4+0 Fraser fir seedlings at a North Carolina nursery. Damage was attributed partially to abnormally high rainfall during the growing season.

Pitch canker,
Fusarium subglutinans

Region 8: North Carolina, Tennessee

Host(s): Longleaf, shortleaf, slash and Virginia pines

Pitch canker was first identified as a tree pathogen on Virginia, shortleaf, and pitch pine in 1946. Since then the pathogen has been found to infect vegetative and reproductive structures. The pitch canker fungus was proven to cause cone mortality and deterioration of seed in slash, Virginia, shortleaf, and longleaf pine orchards. The fungus has also been reported to cause damping-off of southern pine seedlings and other seedling related mortality in first-year pine seedlings. This fungus has proven to be a problem in shortleaf seedlings from mountain-source orchard seed in Edwards State Nursery in North Carolina.

Rhizoctonia needle blight,
***Rhizoctonia* spp.**

Region 8: South Carolina

Host(s): Longleaf pine

Rhizoctonia needle blight caused the loss of 350,000 seedlings in one South Carolina nursery.

Abiotic Damage

Chemical Damage

Region 2: Colorado, Kansas, Nebraska, South Dakota, Wyoming

Host(s): Many hardwood species

Herbicide damage to windbreaks and other tree plantings continues to be a serious problem.

Drought Effects

Region 4: Regionwide

Host(s): All vegetation

Premature needle drop, leaf scorch, and seedling mortality were observed due to 7 years of below-normal precipitation during the last 8 years in the Intermountain Region.

Region 5: California

Host(s): Conifers, some hardwoods

Moisture stress continues to be the primary cause of tree mortality in northern California. Drought-induced white-fir mortality was exceptionally widespread on mixed-conifer sites in northeastern California. In some areas along the California–Oregon border in northeastern California, over 90 percent of the trees are dead due to drought injury. Sugar pine, western white pine, redwood, oaks, manzanita, and other species are also dying prematurely due to lack of moisture.

Flooding/high water

Region 9/Northeastern Area: Iowa, Missouri, Pennsylvania, Vermont

Host(s): Black walnut, hackberry, linden, Norway maple, oaks, silver maple, yellow-poplar

Flooding by the Mississippi and Missouri Rivers in 1994 damaged trees on over 11,000 acres in Iowa and in 32 counties in Missouri. Vermont reported over 9,700 acres were damaged due to flooding/high water in 11 counties. In Perry County, Pennsylvania, yellow-poplar trees were damaged due to flooding.

Heat Injury

Region 8: Oklahoma

Host(s): Hardwoods

A "mini heat wave" occurred in southwest Oklahoma during June 1994 when temperatures ranged from 115-120° F. Trees there exhibited symp-

toms similar to those frequently associated with trees near hot spots in a prescribed fire. Severe wilting occurred in many of the tree plantings in urban areas.

Ozone Injury

Region 5: California

Host(s): Jeffrey pine, ponderosa pine

Ozone-injury to pines in most areas of California has remained about the same or decreased slightly. However, in the southern Sierra Nevada mountains ozone injury has increased. On the Sequoia National Forest, 82 percent of the permanent plots show more chlorotic-mottle injury over the 17-year monitoring period.

Region 8: Regionwide

Host(s): Eastern white pine, various bioindicator species

Symptoms of ozone injury were found throughout the South. Tipburn was observed in several eastern white pine families. Indicator plants were used to assess ozone levels in wilderness areas. Symptoms were found throughout the South. The Class I Wildernesses are surveyed on an annual basis and results are compiled and displayed in tabular format with interpretation as Field Office reports. The reports are used by air resource specialists as tools in permit evaluation. There were slight differences between data collected in 1994 compared to 1993.

Region 9/Northeastern Area: Vermont

Host(s): Black cherry, white ash

In Vermont, 11 of 14 sites statewide had bioindicator plants with ozone injury.

Wind Damage

Region 8: Oklahoma

Host(s): All species

Wind and baseball-sized hail (August 1994) ravaged a rural area near Enid. Trees were stripped of foliage, and bark from smaller branches. Many trees tops were broken.

Winter Injury

Region 3: Arizona

Host(s): Ponderosa pine

Winter injury was observed from aerial surveys on 580 acres of ponderosa pine forests east of White River on the White Mountain Apache Indian Reservation in Arizona. In early spring, needles showed discoloration of

needles occurred throughout the crowns of affected trees. As spring progressed, the older needles fell off, leaving only current-year needles on living branches.

Region 8: Alabama, Arkansas, Louisiana, Oklahoma, Mississippi, Tennessee, Texas

Host(s): All species; predominately pines, oaks and hickories

A severe ice storm (February 1994) caused significant damage to trees and forest stands across the South. Top and limb breakage and uprooted trees were the predominant damage. Extreme disfigurement and decay will result.

Region 9/Northeastern Area: Delaware, Iowa, Maryland, New York, Ohio, Wisconsin

Host(s): Green ash, Jack pine, loblolly pine, Scotch pine, Siberian elm, silver maple, Virginia pine, white oak, yellow-poplar, miscellaneous hardwoods

Over 116,000 acres were damaged by ice/snow during the severe winter in the Northeast. In Delaware, ice storms from February 8 to 18, 1994, damaged trees all over the state, and Kent and Sussex Counties were declared natural disaster areas. In Iowa, over 6,600 trees were damaged due to ice and hail storms. In Maryland, a February ice storm caused scattered branch breakage, top breakage, main stem damage, and trees being uprooted or bent over. In New York, heavy, wet snow in early December broke many branches of hardwoods. Ohio experienced damage at the Shade River State Forest due to ice/snow. Salvage of damaged trees was impossible due to difficult access, sporadic nature of damage, and low value. In Wisconsin, over 2,300 acres were damaged by hail on the Chequamegon National Forest.